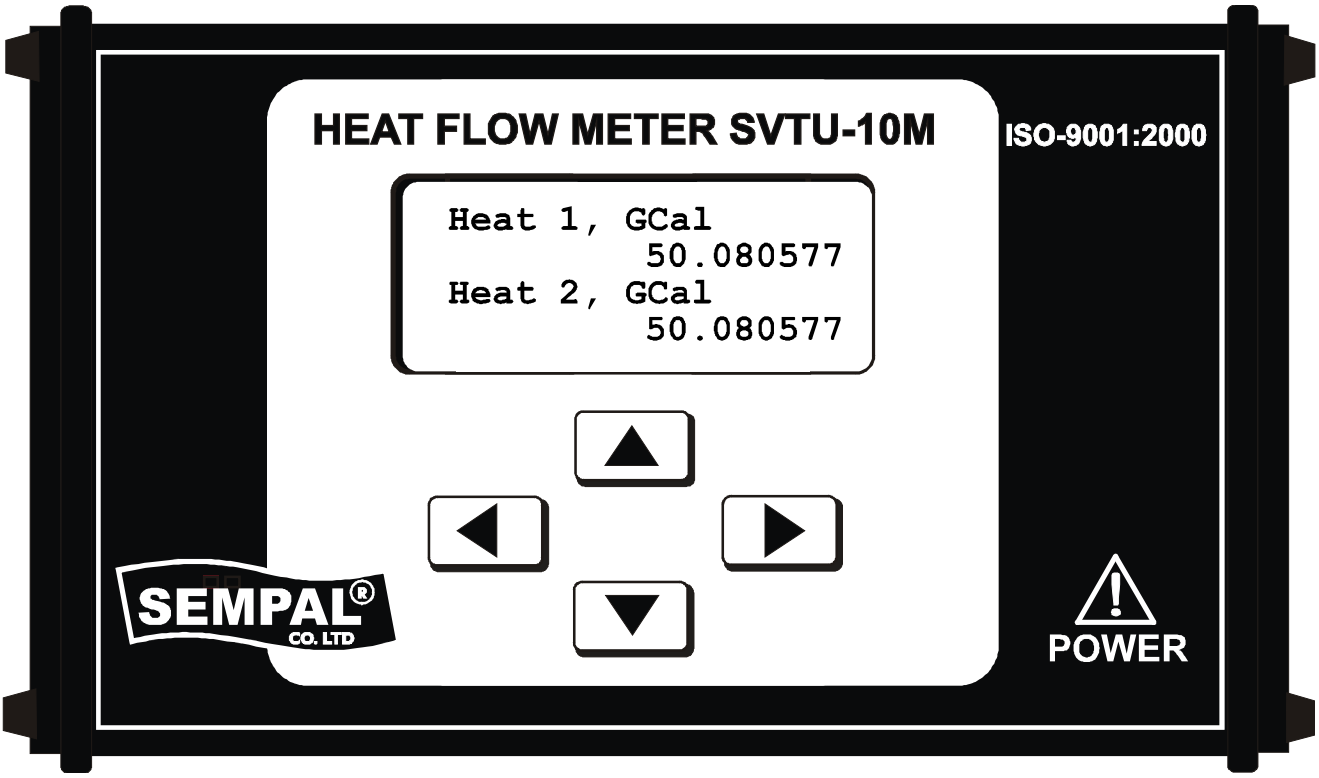
HEAT FLOW METER SVTU-10M

Modifications M1 & M2



Operating manual

SMP.407251.003 OM

(part 1)

March 2010

Documentation:

1 Operating manual SMP.407251.003 OM part 1.
2 Operating manual SMP.407251.003 OM1 part 2.
"Built-in MDM/REG unit – modem connection and regulation unit of heat-flow meter SVTU-10M (M1, M2)"

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Abbreviation list

OM – operating manual.
FS – flow meter section with ultrasonic flow sensors FlS.
RTD – resistive temperature detector.
RTD–S – platinum resistive temperature detector manufactured by SEMPAL Co.
NSC RTD – nominal static characteristic of RTD.
FlS – flow sensor.
TS – temperature sensor.
PT – pressure transducer.

DN – nominal diameter.
PN – nominal overpressure.
PC – personal computer.
RDU – data reader.
X – digit on the device display.
MDM/REG – built-in unit for modem connection and regulation

Information for customers

Heat- flow meters SVTU-10M (hereinafter referred to as meters) are complex measuring devices, which should undergo the starting-up and adjustment works by qualified personnel at commissioning.

Manufacturer's guarantees (48 months since shipment) extend on the meters which were put into operation by the specialized enterprises having corresponding credentials from company-manufacturer. More detailed information is resulted in section 16 ‘Manufacturer’s Guarantee’.

A recalibration interval is 4 years.

The Quality System SEMPAL is certificated under **ISO 9001:2000**.

If you have any questions about purchase, maintenance, operation and service of meters, contact us or our authorized regional representatives.

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1 Preface

The present operating manual (hereinafter referred to as OM) contains information about assignment, field of application, performance capability and completeness, a principle of operating and a design, the order of installation and commissioning, the order of operating and maintenance service of meters.

While meters are in exploitation, it is necessary to be strictly guided by present OM.

Because of the regular work aimed at functional enhancement, improvement of performance capability and increase of meter reliability, manufacturing company SEMPAL Co LTD reserves the right to itself to change a design of the meter without claiming it in present OM.

2 Assignment

Heat-flow meters SVTU-10M are intended for:

- measurements of the produced or consumed heat energy, volume of the heat-carrier, temperature of the heat-carrier in supply and return pipelines, overpressure of the heat-carrier or water, work time (power on time and correct work) or non-work time (power off time), and also calculations of a mass (mass flow rate) of the heat-carrier for configurations 2, 4-9 (see the appendix B);
- measurements of cold or hot water volumes, water temperature, work time or non-work time, and also calculation of the mass (mass flow) of water for configurations 1, 3 (see the appendix B);
- indication (depending on configuration) of the mentioned measured and calculated physical quantities and also heat power, the volumetric flow rate of the heat-carrier or water, overpressure of the heat-carrier or water, current time and date on the indicating device;
- forming of the potential output signals on two independent analog outputs (if there is a built-in MDM/REG unit) in proportion to informative parameters (temperature, pressure, volumetric flow and heat power) measured by the meter. Application of the built-in MDM/REG unit in more detail is specified in item 5.11 and in special manual instruction.

Meters of 7^{th}, 9^{th} configurations also measure temperature of cold water on a source of heat supply (further under the text - cold water temperature).

Meters of 9^{th} configuration also measure volume of water (water leak), used for refill of lost heat-carrier on a source of a heat supply (further under the text - feed water volume).

Meters of 4^{th}, 5^{th}, 7^{th} configurations also indicate the calculated difference of heat-carrier volumetric flows in supply and return pipelines (further under the text - water leak).

2.1 Meters depending on their configuration can be applied for the control of heat energy (in the closed-type or open-type systems of a heat supply) or water volume according to acting rules of the control of heat or water supply and consumption on industrial objects and objects of a municipal services.

Meters of 9^{th} configuration meant for measurement of produced heat energy on a source of heat energy.

2.2 Meters depending on their permissible error limits while measuring heat, volume, volume flow rate and mass of the heat-carrier can be represented in following modifications: M1 and M2.

2.3 Meters with two-chord FS have only M1 modification.

2.4 The meters can work under the following conditions:

— atmospheric pressure can vary from 84.0 up to 106.7 kPa;

— relative air humidity is up to 95 %;

— power supply can vary from 187 up to 242 V, (50 ± 1, 60 ± 1) Hz or DC;

— or power supply is (36 ± 5.4) V, (50 ± 1, 60 ± 1) Hz or DC;

— or power supply is (24 ± 3.6) V, (50 ± 1, 60 ± 1) Hz or DC.

3 Technical specifications

3.1 The meter consists of the following functional units:

— flow meter section with ultrasonic flow sensors (FS);

— resistive temperature detectors (RTD);

— SVTU-10M calculator.

Distinctive functional features of meter configurations and basic functional units are represented in table 3.1. (meter configurations in detail are given in the appendix B)

Table 3.1

Distinctive structural and functional features	Configuration										
	1	2	2/1	2/2	3	4	5	6	7	8	9
1 Number of FS	1	1	1	1	2	2	2	2	2	2	2
2 Number of RTD	1	2	2	1	2	2	2	3	3	4	4
3 Measuring the temperature of the heat-carrier in the return pipeline	–	+	+	–	–	+	+	+	+	+	+
4 Measuring the temperature of cold water	–	–	–	–	–	–	–	+	+	–	+
5 Measuring the temperature in hot water supply system	–	–	–	–	–	–	–	–	–	–	–
6 Measuring the volume of the heat-carrier in the supply pipeline	+	+	–	+	+	+	+	+	+	+	+
7 Measuring the volume of the heat-carrier in the return pipeline	–	–	+	–	–	+	+	–	+	–	–
8 Measuring the volume of water in the water supply system	+	–	–	–	+	–	–	+	–	–	–
9 Measuring the heat energy	–	+	+	+	–	+	+	+	+	+	+
10 Indicating heat-carrier (water) leak	–	–	–	–	–	+	+	–	+	–	–
11 Measuring the volume of water in the feeding pipe	–	–	–	–	–	–	–	–	–	–	+

Additionally the meter can include one or two overpressure transducers (further under the text - pressure transducers or PT), which are used for transformation of the heat-carrier or water overpressure in a range from 0 up to 2.0 MPa (from 0 up to 20 kgf/cm^2) in a proportional electric signal with current from 4 up to 20 mA.

Metrological performance of pressure transducers PT is provided according to the individual order.

Meters can include up to six RTD (fifth and sixth temperature measuring channels are supplied in accordance with the individual order if they have been certified). In that case additional RTD can be used for the control of outdoor temperature.

3.2 Meters indicate the results of measurements in CGS (GCal/h, GCal, kgf/cm^2) unit system or SI (MW, GJ, MPa). At shipment indication of measurement information is set in CGS system.

For the further under the text units of CGS system are used.

3.3 The calculator indicates the following quantities:

— heat energy, GJ (GCal);
— heat power, MW (GCal/hour);
— volume (mass) of the heat-carrier or water, m^3 (ton);
— volumetric (mass) flow of the heat-carrier or water, m^3/hour (ton/hour);
— heat-carrier temperature in supply pipeline, C;
— heat-carrier temperature in return pipeline, C;
— overpressure of the heat-carrier or water, MPa (kgf/cm^2);
— work time and non-work time, hour;
— current time (hours, minutes, seconds) and date.

3.4 The calculator provides storage and output by standard interface RS-232C such archive data as measured values of heat energy and volume (mass) of the heat-carrier (water), work time and non-work time and also average measured values of temperature:

per hour - during 70 preceding days (hourly archive);
per day - within 1 preceding year (daily archive).

3.5 The number of display digits:

— For heat energy, volume (mass) of the heat-carrier or water is 8;
— For heat power, volumetric (mass) flow rate of the heat-carrier or water is 5;
— For heat-carrier temperature in supply and return pipelines, cold water temperature is 5;
— For overpressure of the heat-carrier or water is 3;
— For work time and non-work time, current time is 7;
— For date is 8.

3.6 The minimum bit value of digital display at indication of:

— heat energy - from 10^{-7} up to 1 GCal (from 10^{-7} up to 1 GJ);
— volume (mass) of the heat-carrier or water – from 10^{-7} up to 1 m^3 (from 10^{-7} up to 1 ton);
— volumetric (mass) flow rate of the heat-carrier or water – from 0.001 up to 0.1 m^3/hour (from 0.001 up to 0.1 ton/hour);
— heat power - from 0.001 up to 0.1 GCal/hour (from 0.001 up to 0.1 MW);
— heat-carrier temperature in supply and return pipelines, cold water temperature and water temperature in hot water supply system - 0.01 °C;
— overpressure of the heat-carrier or water – 0.1 kgf/cm^2 (0.01 MPa);
— work time and non-work time – from 10^{-5} up to 1 hour;
— current time – 1 second.

3.7 All performance specifications for SVTU – 10M meters are resulted in the table 3.2.

Table 3.2

Flow measurement section FS	Measurement range of the heat-carrier (water) volume flow, m^3/hour			Range of the heat power, GCal/hour
	Minimal (Qmin)	Transitional (Qt)	Maximum (Qmax)	
FS-32	0.22	0.6	22	from 0.00055 to 3.5
FS-50	0.7	1.4	70	from 0.0018 to 11
FS-65	1.2	2.4	120	from 0.003 to 19
FS-80	1.8	3.6	180	from 0.0045 to 28
FS-100	2.8	5.7	280	from 0.007 to 43
FS-125	4.5	8.8	450	from 0.011 to 68
FS-150	6.5	12.7	650	from 0.016 to 100
FS-200	11.5	23	1150	from 0.028 to 175
FS-250	18	35	1800	from 0.045 to 272
FS-300	26	51	2600	from 0.065 to 393
FS-350	35	69	3500	from 0.087 to 530
FS-400	45	90	4500	from 0.11 to 680
FS-500	71	141	7100	from 0.17 to 1610
FS-600	102	204	10200	from 0.25 to 1540
FS-700	140	277	14000	from 0.35 to 2115
FS-800	180	362	18000	from 0.45 to 2720
FS-900	230	458	23000	from 0.575 to 3475
FS-1000	285	565	28500	from 0.71 to 4275

3.8 The temperature of the heat-carrier in supply and return pipelines can vary in a range from 0 up to 150 C.

3.9 Meters provide heat energy measurement at temperature difference in supply and return pipelines (ΔT) from 0 up to 150 C. If temperature difference varies from 2.5 up to 150C the error of heat measurement is standardized.

3.10 The maximal pressure measured by the meter is 20 kgf/cm^2.

The range of the electric signals proportional to measured pressure should vary from 4 up to 20 mA.

3.11 Meters have standard interface RS-232C, which provides direct connection to the modem, PC and other peripheral devices (see Appendix C).

3.12 Meters can be equipped with two analog electrical outputs of direct current voltage from 0 up to 10 V or two analog outputs of direct current from 0 up to 20 mA proportional to one of the following quantities:

— heat-carrier temperature in supply (return) pipeline, water temperature, cold water temperature;

— overpressure of the heat-carrier (water);

— volumetric flow rate of the heat-carrier (water).

The notice. It is possible to configure analog electric signals proportionally to other measured parameters.

3.13 The nominal supply voltage of meters can be 220 V, or 36 V, or 24 V of direct current or alternate current with nominal frequency of 50 Hz or 60 Hz.

Power, consumed by meters, does not exceed 7 VA.

3.14 Nominal diameters (DN), overall dimensions and the mass of flow measuring section (FS) and also length and mass of RTD depending on their type are indicated in tables 3.5, 3.6, and in the picture 3.1, 9.7.

The notice:

1 It is possible to increase the total length of FS due to the length of straight sections before and after places for ultrasonic flow sensors installation.

2 DN is the designation of internal diameter, which numerical value **is approximately equal** to internal diameter **of attached** pipe sections.

3.15 Meters of 2nd, 5th, 6th, 8th, 9th configurations of M1 modification meet to a grade of accuracy 2, meters of modification M2 meet to a grade of accuracy 2.5 and meters of 4th, 7th, 9th configurations meet to a grade of accuracy 4.

3.16 Limits of heat energy measurement error for meters of modification M1 for 2nd, 5th, 6th, 8th configurations:

— ± 1.5 % (± 4.5 %) ─ while ΔT varies from 20 C (included) up to 150 C (included);

— ± 2 % (± 5.5 %) ─ while ΔT varies from 10 C (included) up to 20 C;

— ± 5 % (± 7.5 %) ─ while ΔT varies from 2.5 C (included) up to 10 C (included).

Limits of heat energy measurement error while heat-carrier flow rate varies from Qmin (included) up to Qt are shown in the brackets.

3.17 Limits of relative error of heat energy measurement by meters of modification M1 for 2nd, 5th, 6th, 8th configurations:

— ± 5 % (± 7.5 %) ─ while ΔT varies from 2.5 C (included) up to 10 C;

— ± 2 % (± 5.5 %) ─ while ΔT varies from 10 C (included) up to 20 C;

— ± 1.5 % (± 4.5 %) ─ while ΔT varies from 20 C (included) up to 150 C (included).

3.18 Limits of relative error of heat energy measurement by meters of modification M1 for 4th, 7th, 9th configurations:

— ± 5 % (± 7 %) ─ while ΔT varies from 2.5 C (included) up to 10 C;

— ± 2 % (± 5 %) ─ while ΔT varies from 10 C (included) up to 150 C (included).

3.19 Limits of relative error of heat energy measurement by meters of modification M2 for 4th, 7th, 9th configurations:

— ± 5.5 % (± 7 %) ─ while ΔT varies from 2.5 C (included) up to 10 C;

— ± 3.5 % (± 5 %) ─ while ΔT varies from 10 C (included) up to 150 C (included).

3.20 Limits of relative error of heat-carrier or water volume (mass) measurement meet to values indicated in table 3.4.

Table 3.3

Flow range	Limits of relative error, %, for modifications	
	M1	M2
From Qmin (included) up to Qt	± 3	± 3
From Qt (included) up to Qmax (included)	± 1	± 2

3.21 Limits of absolute error while measuring a heat-carrier temperature are ± 0.2 °C.

Limits of absolute error while measuring a heat-carrier temperature difference are ± (0.1+0.001·ΔT) C, where ΔT is numerical value of temperature difference, Celsius degrees.

3.22 Limits of pressure measurement error:

— ± 0.5 % , when PT from the SVTU-10M set are used;

— $\pm\sqrt{0.2^2+\delta_{PT}^2}$, when purchased PT are used,

where δ_{PT} is the error limit of purchased PT.

3.23 The calculator provides setting of individual transformation factors for pressure transducers.

Error limits at transformation of inputs from pressure transducers and at indication of heat-carrier or water overpressure are ± 0.2 %.

3.24 Limits of absolute meter error while measuring the time are ± 1 minute per 24 hours.

3.25 Measurement information about heat energy, heat-carrier or water volume and, also, work time and non-work time, is stored in nonvolatile memory within 8 years with power off.

3.26 The maximal heat-carrier (water) overpressure:

— 2.4 MPa (24 kgf/cm^2) for DN up to 600 mm;

— 4 MPa (40 kgf/cm^2) for flow meters with DN from 700 up to 1000 mm.

3.27 Time for setting of the meter's operating mode doesn't exceed 30 minutes after power on.

3.28 Output resistance for analogue outputs is 50 ohm, maximum load current is 10 mA – for direct voltage output.

For direct current output maximum output voltage is less than 15 V.

3.29 Limits of error for analogue outputs:

— ±1% for load resistance more than 20 kOhm – for direct voltage outputs;

— ±1% for load resistance less than 500 Ohm – for direct current outputs.

3.30 Protection class of calculator enclosure is IP 65.

3.31 Calculator mass is no more than 750 gram.

3.32 Calculator overall dimensions don't exceed 170×110×35 millimeters (with device connector and wall mounting accessories – 250×110×60 millimeters (see Appendix D)).

3.33 Nominal diameter (DN), overall and mass of FS, length and mass of RTD are shown in tables 3.5, 3.6 and in fig. 3.1, 9.8.

3.34 Mean error-free work time for meters is not less than 50 000 hours, for calculators – 100 000 hours.

3.35 Total average meter life cycle is not less than 12 years.

Table 3.4
Overall, connecting dimensions and mass of FS (for drawings see Appendix L)

FS	Nominal diameter, mm	Nominal overall and connecting dimensions of FS, mm						n, pcs.	Mass, kg, not more than (no fasts)	
	DN	L	D_f	H	D	d	d1		FS	flanges
FS-32	32	180	Pipe G2”	74	∅32	-	-	-	1.8	2.6*
FS-50	50	180	∅122	173	∅50	∅102	∅11	6	4.8	2.2
FS-65	65	200	∅144	194	∅(62…68)**	∅124			5.8	2.9
FS-80	80	210	∅155	204	∅(76…84)**	∅135			6.9	3.2
FS-100	100	230	∅184	230	∅(95…105)**	∅164		8	7.8	4.1
FS-125	125	265	∅210	270	∅(119…131)**	∅190		10	10.6	5.2
FS-150	150	315	∅236	296	∅(143…156)**	∅212	∅13		20.0	7.7
FS-200	200	540	∅335	360	∅190	∅295	∅22	12	55	22
					∅205				59	
FS-250	250	620	∅405	415	∅235	∅355	∅26		74	30
					∅260				82	
FS-300	300	680	∅460	465	∅285	∅410			95	36
					∅310				103	
FS-350	350	740	∅520	515	∅335	∅470		16	125	52
					∅360				134	
FS-400	400	820	∅580	565	∅385	∅525	∅30		151	58
					∅410				161	
FS-500	500	970	∅710	670	∅480	∅650	∅33	20	280	112
					∅515				300	
FS-600	600	1110	∅840	765	∅585	∅770	∅36		400	162
					∅610				416	
FS-700	700	1240	∅960	855	∅700	∅875	∅45	24	569	244
FS-800	800	1360	∅1075	955	∅800	∅990			764	390
FS-900	900	1500	∅1185	1060	∅900	∅1090	∅52	28	1003	502
FS-1000	1000	1550	∅1255	1160	∅1000	∅1170	∅56		1267	684

* Weight of straight sections with screws.
** Nominal bores D represented in mm

Table 3.5 Types, dimensions and mass of RTD-S

RTD types	Length in mm, no more than		Mass, kg, no more than	Notice
	L_{RTD}	L		
4	58	86	0.06	Type choose depending on DN of pipeline according to figures 9.5 and 9.6
2	80	108	0.08	
3	150	178	0.1	

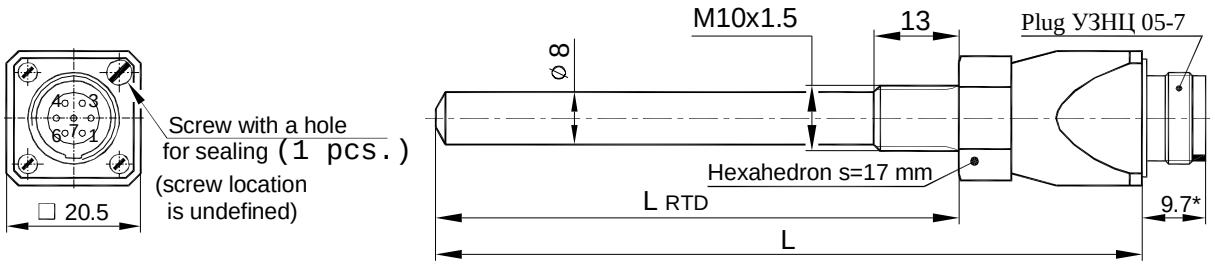


Fig. 3.1

4 Package contents

4.1 The meter complete set of delivery is represented in the table 4.1.

Table 4.1

Name and reference designation	Labeling	Number	Additional information
The SVTU-10M Heat Flow meter includes:	SMP.407251.003	1 pcs.	Configuration and completeness in accordance with the order (see items 1…8)
1. SVTU-10M Calculator	SMP. 408843.003	1 pcs.	
2. Flow meter section (FS) with screws for flow sensors fixing (FS-32 … FS-80 have no mentioned screws in complete set)	Marking from FS-32 up to FS-1000 (included) – in table 4.2	See additional information	Number, configuration and dimension-type in accordance with the order (see Appendixes A, J, L and tables 4.2, 4.3)
3. Ultrasonic flow sensor (FlS) with fluoroplastic seal ring	SMP.407151.009 (for FS-32); SMP.407151.011 (for FS-50…80); SMP.407151.011-01 (for FS-100…150); SMP.407151.008 (for FS-200); SMP.407151.008-01 (for FS-250…1000);	See additional information	Number of FlS for one FS is defined by number of places for their installation in accordance with the order (see table 4.2 and Appendix L)
4. Resistive temperature detector RTD–S	SMP.405212.001-03 (–01,–02)	See additional information	Number and configuration (type) in accordance with the order
5. Overpressure sensors (PS)	Type – in coordination with the customer	See additional information	Number, type and completeness according to the order. Complete set can include elements indicated in Appendix K.
6. Connection cable	SMP.658694.005	1 pcs.	Number of communication lines and their length according to the order (see Appendixes A and J)
7. SVTU-10M Heat Flow meter . Operating manual	SMP.407251.003 OM	1 pcs.	
8. Packaging (set)	SMP.468927.005	1 set	

Name and reference designation	Labeling	Number	Additional information
9. Built-in MDM/REG	SMP.408841.003		By the order
10. Modem	Type – in coordination with the customer		In coordination with the customer while ordering the MDM unit
11. Connector for actuator		1 pcs.	Delivered while ordering the REG unit
12. Regulating valves	Type – in coordination with the customer		According to customer's request while ordering the REG unit
13. Pump	Type – in coordination with the customer		According to customer's request while ordering the REG unit
14. Pump-control unit (adapting REG output)	Type – in coordination with the customer		According to customer's request while ordering the REG unit
15. Diagnostics Device	SMP.408844.002		By the order
16. Power backup module	Type – according to customer's request		By the order
17. Protection enclosure	SMP.301538.006		By the order
18. Instruction. SVTU-10M Heat Flow meter. Calibration principles.	SMP.407251.004 C1	1 pcs.	By the order
19. Reserve belongings	SMP.407251.004-RB		Completeness by the order

Notes

1 FS is delivered with flanges and fasteners (see table 4.3).

2 FS can be delivered with straight pipe sections (length is up to 25 internal diameters of the pipeline). The specified sections can be welded to flanges if it is necessary.

3 While ordering straight pipe sections all necessary materials for installation (for example, electrodes for welding, a paint, sealing materials, etc.) can be delivered additionally.

4 The complete meter set can include six RTD with no PT, or up to five RTD with two PT.

Designation and basic parameters of FS in complete set are indicated in table 4.2.
(For outline drawing of FS see Appendix L)

Table 4.2

FS	Marking on FS	DN, mm	Bore D, mm	Number of places for flow sensors	Labeling
FS-32	DN 32	32	∅32	2	SMP.752292.002
FS-50	DN 50	50	∅50		SMP.302436.007
FS-65	DN 65	65	∅(62…68)		SMP.302436.007-01
FS-80	DN 80	80	∅(76…84)		SMP.302436.007-02
FS-100	DN 100	100	∅(95…105)		SMP.302436.007-03
FS-125	DN 125	125	∅(119…131)		SMP.302436.007-04
FS-150	DN 150	150	∅(143…156)		SMP.302436.007-05
FS-200	DN 200	200	∅190	4	SMP.302436.012
			∅205		SMP.302436.012-01
FS-250	DN 250	250	∅235		SMP.302436.012-02
			∅260		SMP.302436.012-03
FS-300	DN 300	300	∅285		SMP.302436.012-04
			∅310		SMP.302436.012-05
FS-350	DN 350	350	∅335		SMP.302436.012-06
			∅360		SMP.302436.012-07
FS-400	DN 400	400	∅385		SMP.302436.012-08
			∅410		SMP.302436.012-09
FS-500	DN 500	500	∅480		SMP.302436.012-10
			∅515		SMP.302436.012-11
FS-600	DN 600	600	∅585		SMP.302436.012-12
			∅610		SMP.302436.012-13
FS-700	DN 700	700	∅700		SMP.302436.012-14
FS-800	DN 800	800	∅800		SMP.302436.012-15
FS-900	DN 900	900	∅900		SMP.302436.012-16
FS-1000	DN 1000	1000	∅1000		SMP.302436.012-17

Another componentry included in delivery set in accordance with the regular or additional order are indicated in the table 4.3.

Warning!!!

Identification of a FS standard size is provided by the marking of nominal diameter DN on FS body.

Thus numerical value in FS reference designation meets to a numerical value in a designation of a nominal diameter DN (see table 4.2).

Examples:

— marking "**DN 32**" put on the flow meter section with reference designation FS-32. Next element of marking "**PN 16**" means that this flow meter section is intended for use in heat- or water-supply systems with overpressure 1.6 MPa (16 kgf/cm^2);

— marking "**DN 700**" put on the flow meter section with reference designation FS-700. Next element of marking "**PN 24**" means that this flow meter section is intended for use in heat- or water-supply systems with overpressure 2.4 MPa (24 kgf/cm^2).

Table 4.3 Componentry included in delivery set

№	Name	Labeling	Assignment	Number	Set of delivery	
					obligatory	By the order
1	Pipe nipple	SMP.302661.002	Connection of FS-32 to a pipeline (straight-line section)	2 pcs. per 1 FS	+	
2	Sleeve nut	SMP.758422.001	For mounting FS-32		+	
3	Flange	SMP.711154.004…004-05 (according to the DN FS)	For mounting FS-50…150		+	
4	Flange	SMP.711154.008-18…-35 (according to the DN FS)	For mounting FS -200…1000		+	
5	Gasket (paronite)	SMP.754152.009	Sealing of flanges FS-32		+	
6	Gasket (paronite)	SMP.754152.007…007-16	Sealing of flanges FS-50…1000		+	
7	RTD pocket (L_{RTC}=58mm, type 4)	SMP.753137.002-03	Protection of the RTD from hydraulic impacts	1 pcs. per 1RTD		+
8	RTD pocket (L_{RTC} =80mm, type 2)	SMP.753137.002-01	Protection of the RTD from hydraulic impacts			+
9	RTD pocket (L_{RTC} =150mm, type 3)	SMP.302634.002	Protection of the RTD from hydraulic impacts			+
10	Sealing ring (fluoroplastic)	SMP.754176.003	Sealing of the RTD		+	
11	Sealing ring (fluoroplastic)	SMP.754176.003-01	Sealing of thermometer pocket for RTD			+
12	Bush (for angle α=45º)	SMP.723144.007	Installation of the RTD without thermometer pocket	1 pcs. per 1RTD	+	
13	Bush (for angle α=60º)	SMP.723144.008			+	
14	Bush (for angle α=90º)	SMP.723144.009			+	
15	Bush (for angle α=45º)	SMP.723144.007-01	Installation of the thermometer pocket for RTD	1 pcs. per 1 thermometer pocket		+
16	Bush (for angle α=60º)	SMP.723144.008-01				+
17	Bush (for angle α=90º)	SMP.723144.009-01				+
18	Connecting pipe (M20x1.5/K3/8”)	SMP.716161.001 (see draft in Appendix K)	For pressure sensor mounting	1 pcs. per 1 PS		+
19	Gasket	SMP.754156.001	Sealing of device connector	1 pcs.	+	
20	Set AB 1000WLV: - crampon	No marking	Mounting of the calculator	2 pcs.	+	
	- corbel			2 pcs.	+	
	- washer «star»			2 pcs.	+	
	- screw M4 (hex)			2 pcs.	+	
Fixings: (thread diameter d and bolt length L fit to holes in flanges and total flange thickness)						
21	- screw M3x10	GOST 17473-80	Mounting of the connector	4 pcs.	+	
22	- washer 3	GOST 10450-78 or 11371-78		4 pcs.	+	
23	Bolts A. (dxL).88.35.019	GOST 7805-70	FS-50…-150	According to the total number of holes in FS flanges (App. L and table 3.3)	+	
24	Nuts A. (d). 9.35.019	GOST 5927-70			+	
25	Bolts A. (dxL). 46	GOST 7798-70	FS-200…-800		+	
26	Nuts A. (d). 5	GOST 5915-70			+	
27	Washers (d). 5	GOST 11371-78			+	

5 Structure and functioning of meters

5.1 The principle of heat-carrier (water) flow measurement is ultrasonic time-of-flight. The time for the sound to travel between a transmitter and a receiver is measured. The time difference is proportional to the average fluid velocity and flow rate correspondingly. The integrated momentary flow rate values give the information about heat-carrier (water) volume which has passed through FS. The heat-carrier (water) mass is calculated as a function of volume and density of the flow depending on its temperature.

Fluid velocity can be measured by one path or two paths. One path is arranged in the diametric flow meter cross-section, whereas two paths are arranged in two-chord planes.

5.2 Heat-carrier (water) temperature is measured by platinum resistive temperature detectors.

5.3 Each measuring run for 1-2 seconds and includes both measurement of the heat-carrier parameters and process of device self-diagnostics. The measuring information about the momentary heat-carrier flow rate, heat-carrier temperature in the supply and return pipes in the form of electric signals goes to the calculator. The calculator transforms this information into the digital form and calculates heat energy, heat-carrier (water) volume (mass), heat-carrier temperature in supply and return pipelines and also measures work time and non-work time.

5.4 Heat Flow meters have 9 configurations. Depending on the configuration measured parameters and computing algorithms for thermal energy can be changed.

In resulted below expressions the following designations are used:

— W is a heat energy (Joule);

— H is a specific enthalpy (Joule /kg);

— Q_m is a mass flow rate (kg/hour);

— t is time (hour).

The specific enthalpy is a temperature and pressure function, therefore for increase of enthalpy calculation accuracy during meter commissioning the overpressure values for corresponding pipelines are entered in meter memory.

When pressure sensors are included in the delivery complete set the results of pressure measurement are used as overpressure value in the supply (PT1) and return (PT2) pipelines while calculating the heat energy (in 8^{th} configuration measured pressure values are not used for heat calculation). In the case of PT malfunction the overpressure value, which was set during meter start-up is used for heat calculation.

Entered (measured) pressure values are displayed in records as P1, P2 and Pcold. So if the meter doesn't include PT then entered values are recorded. If the meter is completed with PT, then measured values are recorded. For configuration 8 the only measured pressure values are recorded.

In 4^{th} configuration the cold water temperature value entered by user (not measured) is considered and can be changed independently. Thus any change of cold water temperature is fixed in the event journal.

Entered value of cold water temperature can be changed from 0 up to 25.5 C with 0.1 C resolution. *If the value 0.0 C was entered the specific enthalpy value is identically equated to 0.*

Bringing into service meter configurations with the entered cold water temperature it is necessary to consider, that the thermal energy measured by a heat meter mismatches thermal energy which has been produced by the heat supplier. It is because the entered temperature of cold water is not equal to the valid temperature of cold water which changes in time. In this case at settlement with the heat supplier it can be demanded (depending on requirements of settlement rules between the supplier and the consumer) a corrective action according to applicable normative documents.

Schemes for sensors connection in different configurations are represented in Appendix B.

5.4.1 **Closed heat supply systems** (heat meter configurations 2, 5, 6 and 8). Heat energy is determined as:

$$W = \int_t Q_m \cdot (H_1 - H_2) \cdot dt \qquad (5.1)$$

where Q_m is heat-carrier mass flow rate in supply pipeline, kg/hour;

H_1 and H_2 are heat-carrier specific enthalpies in supply and return pipes of the heat-exchange system, correspondingly, Joule/kg;

t is operating time, hour.

5.4.2 **Open heat supply systems** (configurations 4 and 7):

$$W = \int_t Q_{m1} \cdot H_1 \cdot dt - \int_t Q_{m2} \cdot H_2 \cdot dt - \int_t (Q_{m1} - Q_{m2}) \cdot H_{cold} \cdot dt \qquad (5.2)$$

where Q_{m1} and Q_{m2} are heat-carrier mass flow rates in supply and return pipelines, correspondingly, kg/hour;

H_1, H_2 are heat-carrier specific enthalpies in supply and return pipelines, correspondingly, Joule/kg;

H_{cold} is cold water specific enthalpy.

In 4th configuration we don't measure cold water temperature, but enter it programmatically (this temperature is entered by user).

Meters of configurations 4 and 7 measure heat-carrier flow rate in supply and return pipelines and ***calculate*** flow rate difference ΔG_M. Meters of configurations 4 and 7 ***don't measure*** water leaks, water leak is ***calculated*** as flow rate difference in supply and return pipelines.

5.4.3 Source of heat supply (configuration 9).

$$W = \int_t Q_{m1} \cdot (H_1 - H_2) \cdot dt + \int_t Q_F \cdot (H_2 - H_{cold}) \cdot dt \qquad (5.9)$$

where Q_{m1} and Q_F are heat-carrier mass flow rates, correspondingly, in supply and feeding pipelines, kg/hour;

H_1, H_2, H_{cold} are heat-carrier specific enthalpies, correspondingly, in supply, return and cold water pipelines, Joule/kg.

5.5 Calculation (and archiving) of average temperature values which are included in process of heat energy determining for a time interval t_0-t_1, is carried out as weighted average value $\overline{T}_\int$ defined under the following formula:

$$\overline{T}_\int = \frac{\int_{t_0}^{t_1} T(t) \cdot Q_m(t) \cdot dt}{\int_{t_0}^{t_1} Q_m(t) \cdot dt} \qquad (5.10)$$

where T(t) are momentary (current) measured temperature values;

$Q_m(t)$ are momentary (current) measured heat-carrier (water) mass flow rate values.

For discrete in time measurements carried out by device each 1-2 seconds, the following formula is used

$$T_{W.AV} = \frac{\sum_i T_i \cdot Q_{mi}}{\sum_i Q_{mi}} \qquad (5.11)$$

where T_{mi} and Q_{mi} are heat-carrier temperature and volume flow rate for i-th measurement, correspondingly.

In the absence of the heat-carrier volumetric flow the temperature is calculated as an arithmetical mean value of all measured temperature values for the given time interval.

For temperatures which are not applied for heat calculation the mean temperature is calculated.

5.6 The meter carries out flow measurement in the range from 0.5Qmin up to 2Qmax, where Qmin and Qmax are accordingly, the minimal and maximal volumetric flow rates of the heat-carrier (see table 3.2).

For the SVTU-10M measurement errors specified in present OM, are provided in a range [Qmin; Qmax], but in subranges [0.5. Qmin; Qmin[and]Qmax; 2. Qmax] the mentioned measurement errors are not standardized, however device working capacity is kept, and the heat-carrier mass storing and heat calculation are carried out.

5.7 If the measured instantaneous flow rate values Qmeas < 0.5Qmin the device indicates 'zero-flow' message and mass storing $m=Q\cdot\rho$ isn't carried out.

5.8 Measurement of the heat-carrier (water) overpressure is carried out by transformation of electric signal from the pressure sensor into the digital format with its indication on the calculator display. Overpressure values P_{op} (kgf/cm^2), measured and displayed by the calculator, and current I_{in} (mA) on an input of pressure measuring channel (on the calculator input) are connected by a following ratio:

$$P_{op} = (I_{meas} - I_1) \cdot \frac{(P_2 - P_1)}{(I_2 - I_1)} + P_1 \qquad (5.12)$$

where P_1 and P_2 are pressure values in two points of pressure transducer characteristic (for example, minimal and maximum pressure);

I_1 and I_2 are correspondingly currents on the PT outputs in the above specified points;

U_{meas} is value of measured current on the output of PT.

5.9 Measuring time parameters the meter carries out measurement of following quantities: time of correct work (running or work time), time of incorrect work (time of errors), power on time, power off time (non-work or idle time), and also displays current (taking into account summer/winter) time.

Time of correct work (running time Trun or work time) – device operating time (power on, no error messages). Time of correct work on 1-st and 2-nd channels is displayed on the heat meter indicator in a mode **«Indication of additional parameters»** (see item 11.2.2, table 11.3 of present OM, and also appendix E, figure E-2).

Time of incorrect work (time of errors Terr) – device operating time (power on, there are error messages). **Terr** values for 1-st and 2-nd channels are presented in printouts

of stored data archives and error archives (see item 11.2.3, table 11.4., and also Appendixes E (figure E-5), I, of present OM).

Power on time Tpower – total time when the device power supply voltage is on. It is indicated on the heat meter display in a mode **« Indication of additional parameters »** and **«Check»** (see item 0, table 11.3 of present OM, Appendix E (figure E-2)), and also is presented in a daily archive printout (see Appendix I).

Power off time (idle time Tidle or non-work time) – total time when the device power supply voltage is off. It is displayed on the heat meter indicator in a mode **« Indication of additional parameters »** (see item 0, table 11.3 of present OM, Appendix E (figure E-2)), and also is presented in a daily archive printout (see Appendix I).

Current time – current calendar time (taking into account summer/winter). It is displayed on the heat meter indicator in a mode **« Indication of additional parameters »** (see item 11.2.1, table 11.2, and also Appendix E, figure E-1 of present OM).

Measurement, indication and registration of above-listed parameters are carried out in hours. In figure 5.1 the timing sheet is represented. It explains how time of correct work **Trun** and time of non-working condition **Tnw** for accounting period **Tacc** are resulted. During **Trun** authentic measurement of all parameters was made**,** during **Tnw** there is no registration of any parameter or there is no power supply voltage.

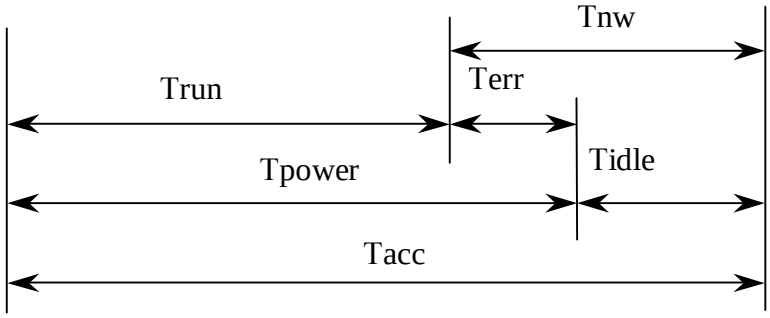


Figure 5.1

5.10 The SVTU-10M heat meter can be connected to external devices for

- data collection;
- registration of analogue signals;
- control of threshold devices;
- creating different regulation circuits;
- organizing communication with heat meters via modem connection;
- data transfer and storage with its next processing on PC.

Meter can be equipped with the built-in MDM/REG unit. This block expands communication capabilities.

Without **MDM/REG** the meter can communicate by RS-232C with any PC or data reader, which use this interface (use only TxD and RxD lines).

Having the **MDM/REG** unit the device can communicate via RS-232C with modem (GSM/GPRS or telephone line modem), PC or data reader. Moreover, device can connect with each other one by RS-485 (line length up to 2 km). In this case it is enough to have an external communication line output (for the modem, direct communication with a computer) for only one of devices. Besides RS485 can be connected directly to a computer through any standard converter of interfaces RS232/RS485.

The **MDM/REG** unit provides temperature regulation in two channels (two linear 0…10 V outputs) and control of one pump (one switch output).

5.11 The description of the basic functionalities of analog outputs is resulted below.

5.11.1 The SVTU-10M heat meter forms output signals Y on three programmatically configured outputs (see figure 5.2) while processing measured information X. The parameter setting guideline for analog outputs is given in additional operating manual (it is attached if meter is delivered with analog outputs).

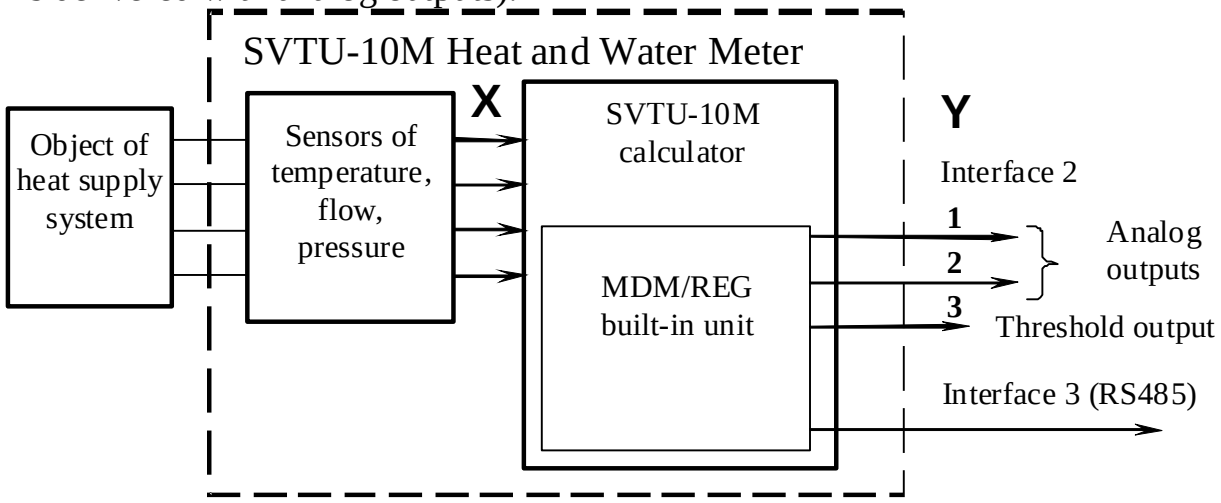


Figure 5.2

Each output is configured irrespective to another one and can be applied as follows:

5.11.2 Forming of the potential output signals Y proportional to informative parameters X measured by the meter. In this case signals on meter analog outputs (potential or current outputs) can be used by various registration devices (for example, recorders).

Informative parameters X are as follows:

— t1, t2, t3, t4, t5, t6 are temperatures measured by temperature sensors TS1…TS6, correspondingly;
— P1, P2 are pressures measured by pressure sensors PS1 and PS2, correspondingly;
— Q1, Q2 are heat-carrier (water) volumetric flow rates measured in first and second measuring channels.
— T is time (hour: minutes) – only for outputs, configured as threshold. In this case time of switching on and switching off is set.

The notice. Two outputs can be configured as linear or as threshold, the third output is always threshold.

While configuring outputs two threshold values (switching on and switching off) are set independently.

5.11.3 The MDM/REG unit can be used as two-channel regulator with potential outputs. In this case both of analog outputs can operate regulating valves and the third (threshold) output can operate a pump. Regulation can be carried out according to following parameters:

— **temperature**. Maintenance of fixed temperature basing on any of measured temperatures;
— **heating regulation**. In this case the temperature **of the return** pipeline is regulated with correction by **outdoor** temperature.

The ‘day’ and ‘night’ regulation mode and also ‘weekend’ mode are set.

While completing the MDM/REG unit with current (instead of potential) outputs it can't be applied as a regulator.

5.11.4 Parameters of regulation can be set remotely if the meter has a connection to a computer.

5.12 The MDM/REG unit description is given in Operating manual SMP.407251.003 OM1 part 2. "MDM/REG built-in unit– modem connection and regulation unit of the SVTU-10M (M1, M2) heat-flow meter"

5.13 Structurally the meter consists of several units (the calculator, temperature detectors, flow meter section with ultrasonic sensors, pressure sensors).

5.13.1 The calculator housing has four control buttons, the digital display (4-line 64-digit liquid crystal indicator), slots for connecting cables and a power cable outlet.

Heat meter control buttons are described in chapter 11 and Appendix E.

5.13.2 In a heat meter the liquid crystal indicator with illumination is applied. Computational algorithm of illumination is following:

— after power switching on the device backlight LCD is automatically switched on and after several seconds it is automatically switched off;
— if at the moment of pressing the button backlight has been switched off, it is switched on, but change of the information on the indicator and switching of operating modes don't occur. The further push-button carries out standard functions;
— time of a backlight is 15 minutes after last pressing any button.

5.13.3 FS is a pipe section with flanges and bushes for ultrasonic flow sensors. Geometrical dimensions of FS (linear and angular) have rigid tolerances. This is necessary for achievement of required measurement accuracy and work stability (see the table. 3.3 and appendix L).

For all flow meters with DN 200 and more duplicate flow sensors set is provided.

It means that single-beam flow meter has four flow sensors (one pair is duplicate), two-beam flow meter has eight flow sensors (two pairs are duplicate).

Caution: selection of duplicate pair of flow sensors in two-beam flow meter is permitted only for pair, which is located in the same plane as the basic one.

5.13.4 RTD are installed in pipelines with application of bushes or thermal pockets (according to the order) on supply and return pipes of heat exchange system.

5.13.5 The length of connecting cables is determined according to a lay-out of meter components and can be within the limits:

- from 2 up to 100 m for ultrasonic flow sensors and temperature sensors;
- from 2 up to 200 m for interface while connecting to PC;
- from 2 up to 100 m for interface using analog outputs.

5.14 Control board is structurally made in form of rectangular box-safe and intended for mounting and connection of complex equipment produced by SEMPAL Co LTD.

6 Marking and sealing

6.1 Meter marking on the calculator contains the following data:

— name and reference designation of meters;

— manufacturer trade mark;
— the type approval sign;
— meter modifications – M1 or M2;
— works number (on a lateral cover), which consists of five-digit serial number and two (or four) digits before the serial number, designating year of meter release;
— power supply voltage, power consumption.

Serial numbers of the RTD and FS are put on their bodies by an impact method or a method of engraving.

6.2 Marking of FS contains value of internal diameter DN and the maximal operational value of overpressure PN (FS).

6.3 Meter components are sealed up to prevent a non-authorized access.

6.3.1 The calculator is sealed up by two mastic seals. Seals are put on fixing screws on lateral covers. For mastic fixing under screw heads sealing cups are provided.

For realization of additional sealing by means of a lead seal, the screws with holes in heads on lateral covers are stipulated. On customer's demand the replacement of these screws by additional sealing cups is possible.

7 Packing and marking

7.1 Marking of transport container has specific instructions "CAUTIOUSLY FRAGILE", "PROTECT FROM MOISTURE", "TOP".

7.2 Meter components are packed into the boxes in accordance with drawings of manufacturer.

In coordination with the customer FS delivery without transport container or in customer's container is possible.

8 Safety precautions

8.1 Electric isolation of meter power circuits with a supply voltage 220 V stands a test direct current voltage 2100 V during 1 minute without damages.

8.2 Electric isolation of meter power circuits with a supply voltage 36 V or 24 V stands a test direct current voltage 700 V during 1 minute without damages.

8.3 Electric isolation of power circuits of device enclosure stands a test alternate current voltage 1500 V during 1 minute without damages.

8.4 Electric resistance of isolation for meter power circuits with a power supply voltage 220 V is not less than:
— 20 MOhm - while the temperature is 20 C and relative humidity is up to 80 %;
— 1 MOhm - while temperature is 35 C and relative humidity is 95 %.

8.5 Electric resistance of isolation for meter power circuits with a power supply voltage 36 V or 24 V is not less than 1 mega ohm.

8.6 Electric resistance between ground contacts of a three-polar plug of power cable and metal parts of the calculator case is no more than 0.1 Ohm.

Electric resistance between ground contacts of three-polar sockets of device enclosure and its case should be no more than 0.1 Ohm.

8.7 Working with meters it is necessary to observe operating safety precaution rules for work with electrical facilities.

Warning! Using the transformer as the meter power supply with a power supply voltage 36 V or 24 V, input and output transformer windings should **be galvanically separated** and **a double** or **strengthened isolation should be provided between them**.

9 Installation

9.1 Unpacking and degreasing

Unpacking and degreasing of meters are carried out after their being indoors within 2 hours, while ambient temperature varies from 10 up to 30 C and relative humidity is no more than 80 %.

To make unpacking, please follow the instructions:

- open packing boxes;
- take a package with the calculator and operational documentation;
- check up completeness of meters in accordance with the order (see Chapter 17);
- take meter components from packing boxes, make an external survey and be convinced of absence of mechanical damages, coating infringements and isolation of connecting cables.

9.2 Installation Requirements

9.3 Installation of meter components is carried out in accordance with chosen configuration, necessity of application of the additional equipment, and also parameters of heat consumption object.

9.3.1 Basic schemes for meter installation according to their configurations are represented in Appendix B.

The example for connection of additional equipment to meters of configuration 2 is resulted in the appendix C. Connection of the additional equipment is not obligatory and discussed with the consumer.

9.3.2 Climatic conditions in a room, where meter components are installed should be as follows:

In a place for FS and RTD installation:

- ambient temperature can vary from –40 C up to +70 C;
- ambient humidity is up to 95 %, while temperature is 35 C;

In a place for calculator installation:

- ambient temperature can vary from 0 C up to +50 C;
- ambient humidity is up to 80 %, while temperature is 25 C.

Climatic conditions in a mounting place for the additional equipment should meet the conditions resulted in the operational documentation for this equipment.

9.3.3 External conditions have a great impact. It means that the device can be installed on the object where interference level has a bad influence on its work. Choosing an installation place for the device it is necessary to avoid the vicinity of underground railway (pulse interference in a power line), nearness of high-voltage lines, powerful electromotors (splashes in a power line) and the equipment with big transformers (magnetic inductions). At presence of interferences the length of communication lines between FS, RTD and the calculator should be minimal and their length is determined by a noise level on a certain object.

For reduction in a noise level from power line, installation of network radio-frequency filters is recommended. The level of electromagnetic interferences can be lowered by additional measures on electromagnetic shielding, both the device and an interferer. The effec-

tive measures for reduction of interference influence are minimization of lengths of connecting lines.

9.3.4 Protection of places for FS and RTD installation from direct ingress of moisture, dirt, oils and aggressive liquids should be provided.

The content of acid and alkali fume in air of premises, where meter components are installed, should be within the limits of sanitary code and rules.

At outdoor FS installation it is recommended to provide protection against direct ingress of atmospheric precipitates on ultrasonic flow sensors.

FS installation in places with possible short-term water flooding is allowed while observing following protection measures for FS and entrance cables:

— the lining of cables should be made in protective waterproof pipes, which are resistant to influence of an environment (including the increased temperature);
— places for connection of protective pipes to ultrasonic flow sensors or RTD should be protected from water influence by means of tight clutch, profile sealants or other ways recommended by the manufacturer of protective pipes.

9.4 Installation of flow measuring section

FS installation place should be as much as possible removed from sources of vibrations, jolting, electromagnetic interferences (electromotor, pumps, compressors, etc.). No electric voltage relative to a protective contour of grounding in the place, where FS should be installed.

The distance between flow meter section and an installation place for the calculator should be minimal and not exceed 100 m.

In all cases it is necessary to locate FS in the pipeline area providing its full filling with water otherwise meters stop functioning, and malfunction (see Chapter 13 of OM) is diagnosed.

Flow meter sections can be installed in vertical position, however submission of the heat-carrier thus should be carried out in a direction bottom-up for providing FS with water filling.

Heat meter operation in special conditions (incomplete filling of FS with the heat-carrier or polluted heat-carrier) determines its location as resulted in figure 9.1. In this case complete water filling of FS is guaranteed. The most polluted pipeline section appears in a place below FS.

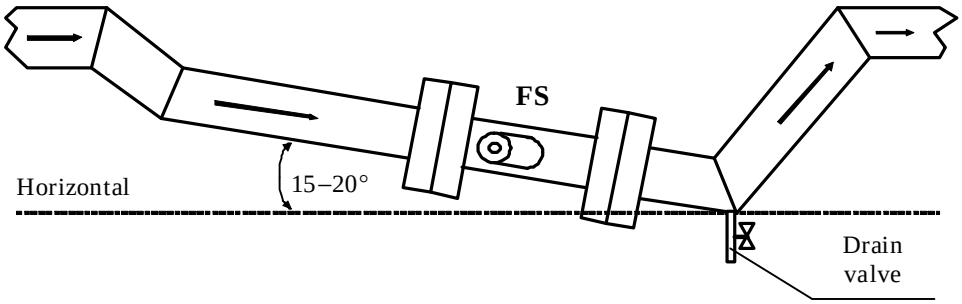


Figure 9.1

For the removal of heat-carrier rests from the bottom part of the pipeline (see figure 9.1), it is possible to provide the drain valve.

At installation please follow the requirements resulted below.

The pipeline section chosen for FS cut-in, should be located in horizontal plane (a deviation from a horizontal within the limits of ± 20 °).

Bushes for flow sensors are also mounted in horizontal plane with a deviation from a horizontal no more than ± 20 °.

Distances downstream of flow disturbances in accordance with specified meter accuracy should be not less than mentioned in the Table 9.1.

Table 9.1

Flow Disturbance	Modification M2	Modification M1		
		DN < 200	DN ≥ 200**	
			1 beam	2 beams
Conical Contraction with an angle no more than 20 °	7 DN	10 DN	15 DN	10 DN
Single 90 ° Bend	10 DN	15 DN	50 DN	15 DN
Gate valves* or two 90 ° Bend in perpendicular planes	15 DN	20 DN	70 DN	20 DN
Pump	20 DN	30 DN	90 DN	30 DN

Remarks:

* Completely open globe valve is not considered as a disturbance.

** Designations «1 beam» and «2 beams» mean that flow measuring sections have one diametric path and two-chord paths correspondingly.

The straight pipe section between two serial flow disturbances should be not less than 5 DN. Otherwise upstream straight section should be increased by the length equal to a difference (in millimeters) of the required and real distances between disturbances.

Distance downstream of FS should be not less than 5 DN for modification M2 and 10 DN for modification M1 for one-beam FS and 5 DN for two-beam FS.

If DN of supply pipeline and DN of straight sections are different then application of conical contraction is required.

The straight pipe distance downstream a conical contraction should meet the requirements for all flow meters.

To calculate the length of straight sections we use distance equal to DN in mm for appropriate standard size of FS (DN 32 means 32 mm, DN 50 means 50 mm etc.).

It is not supposed to install any kind of disturbances on straight sections upstream of a flow meter.

Internal diameter of a straight pipeline section should not differ more than on ± 5 % from:

— digital value of DN in mm for FS with DN20, DN32, DN50. In other words, nominal value of internal diameter of straight section should be 20 mm, 32 mm and 50 mm correspondingly;

— real diameter of FS, which is resulted in Chapter 17 “Parameters and characteristics of meter components” for FS with DN65…DN1000.

For modification M1 deviation of internal diameter of straight section is permitted, but no more than + 5 % (negative deviation is not acceptable).

9.5 **Installation of meter components**

9.5.1 Installation of FS

9.5.1.1 FS is insertion type of a flow meter.

9.5.1.2 Delivery sets with FS of DN32 include special pipe branches (nipples), which are welded to straight sections of the pipe during installation.

For the rest of FS the straight sections are included in delivery set according to customer's request.

Pipe branch with sleeve nut, which is included in delivery sets for FS of DN20 and DN32, is a part of straight section and applied for further welding to pipeline to create required distance of straight section.

The axis of a branch pipe and straight section should be a uniform coaxial line without significant jogs and bends. Transition 'jump' from a branch pipe to a pipe should not exceed 0.8 mm (± 2.5%) for FS of DN32.

9.5.1.3 While connecting flow meter's flange to the pipe, the flange bore can be reamed to external pipe diameter with the least allowable tolerances. The schemes for flange welding are resulted in Fig. 9.2 and Fig. 9.3.

Flange mounting to the pipeline should be carried out without metal sagging on the internal pipe surface. Otherwise change of velocity profile can lead to additional meter error.

After flow meter installation the flange painting should be done.

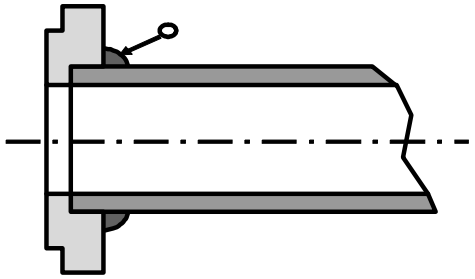


Figure 9.2

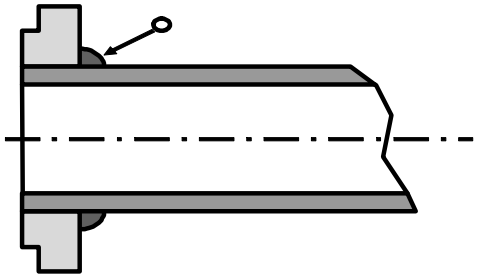


Figure 9.3

WARNING!

Please avoid welding of flanges to the pipeline if FS has been installed! It can lead to flow meter damage because of overheating

9.5.1.4 Pressure losses

Pressure losses at maximal flow rate Qmax don't exceed 0.085 kgf/cm^2 (for all flow meters, if there are no additional remarks).

Pressure loss for flow meters of DN32 (with straight sections DN 32) in kgf/cm^2 is shown on the plot (see fig. 9.4).

The curve 2 demonstrates pressure loss directly on the flow meter of DN32. The curve 1 demonstrates pressure loss on the flow meter, straight sections and conical 10° contractions, while installing the flow meter of DN32 on the pipe of DN 50.

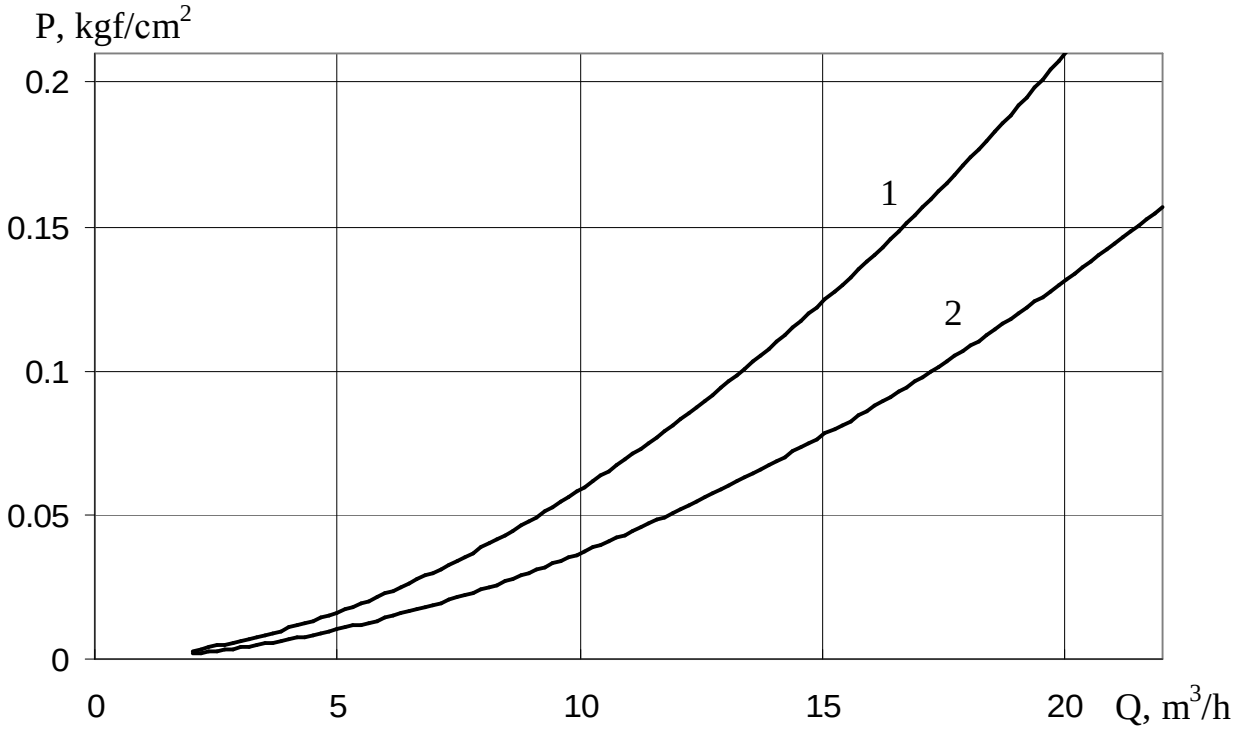


Figure 9.4

For flow meters of DN50 the pressure loss is resulted in Fig. 9.5.

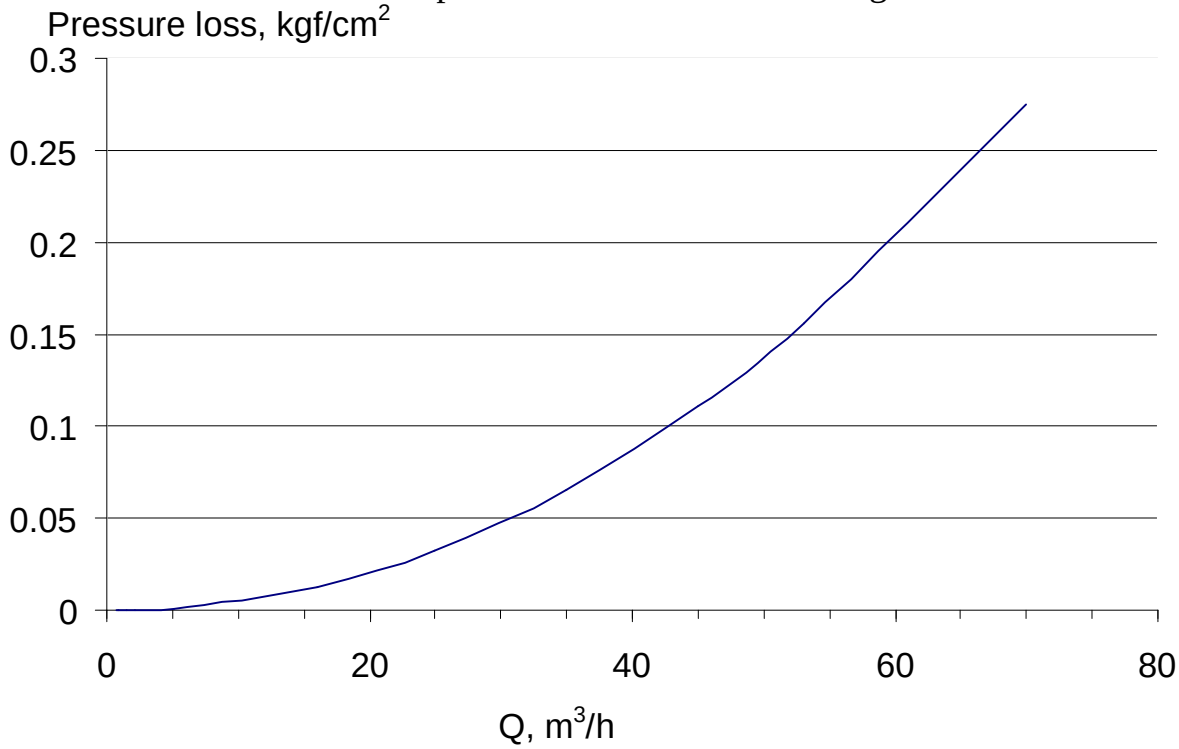


Figure 9.5

9.5.2 Installation of flow sensors

9.5.2.1 The order for installation of flow sensors FlS is applied for FS of DN 32… DN1000.

9.5.2.2 After FS installation on the pipeline it is necessary to install ultrasonic flow sensors as follows:

— clean a dust and dirt on internal surfaces of bushes if necessary;
— for protection of fixing nut and flow sensor materials from diffusion with material of FS it is necessary to grease a bush thread and a lateral cylindrical surface of ultrasonic flow sensors with graphite greasing;
— FlS effective area (edge) should be cleaned from greasing;
— insert ultrasonic flow sensors in bushes (pipe-bends) of flow measurement section. Marking* is put on sensor cable outputs for modification **M1**. So FlS with marks "11" (or "21" for the second flow measurement channel) should be inserted in first (according to flow direction) FS bush, FlS with marks "12" (or "22" for the second flow measurement channel) should be inserted in second (according to flow direction) FS bush **. To connect FLS of two-path flow meter it is necessary to follow guidelines in the table 9.5
— at tightening of flow sensor's fixing nut the force put to a wrench should be equal to 40 … 45 N·m and provide a 'zero' gap between FS surface and FlS ring surface outside of its sealing gasket. For FlS installed in FS of DN32 the force is 18 … 20 N·m.

* On sensor cable outputs for modification **M2** marking is not required.

** The instruction is obligatory only for meters of modification **M1**.

WARNING!

Ultrasonic flow sensors contain piezoceramic elements and thin-walled design elements, which have the increased fragility and do not permit shock and excessive compressing loads.

That is why

IT IS FORBIDDEN:

— to swap around flow sensors of different channels;
— to install flow sensors with marks "11" ("21"), intended for installation in the first flow meter bush (according to flow direction), in the second bush and sensors with marks "12" ("22") to install in the first bush (the instruction is obligatory for meters of modification **M1**).
— to drop ultrasonic flow sensors or to knock on them at transportation and installation;
— to carry out mounting and dismantling of FS with installed ultrasonic flow sensors;
— to accomplish metalwork or welding works on the pipeline close to FS with the installed ultrasonic flow sensors;
— to exceed the mentioned above force for tightening of FlS;
— to dismount stuck to FS flow sensors, while turning them in bushes during regular service.

9.5.2.3 For the removal of the flow sensor its design provides special elements.

The manufacturer has developed and can propose special removers or complete set of design documentation for their manufacturing.

The soldering and pinout schemes for connectors of flow sensors are resulted in the appendix G.

9.5.3 Installation of temperature sensors

Temperature sensors (manufactured by SEMPAL Co.) **RTD-S** can be installed in two ways:

— by screwdriving in bushes (lugs) of the first type welded into the pipeline for direct contact of the RTD with the heat-carrier;

— by screwdriving in thermal pockets, which, in turn, are screwed in bushes (lugs) of the second type. The last ones are welded into the pipeline for contact with the heat-carrier via a protective thermal pocket.

Choosing a way of RTD installation in the pipeline it is necessary to consider, that to obtain a maximal accuracy of temperature measurement the sensitive element of RTD should be arranged more close to an axis of the pipeline. There are five types of RTD with length of 58, 80, 150, 310, 360 mm (type 4, 2, 3, 5 and 6 correspondingly) and variants of their angular installation in accordance with specified requirement irrespective of pipeline diameter. The inclination angle and depth of RTD immersing is provided with use of bushes (lugs), the design of which depends on pipeline DN. Variants of RTD installation are given in the table 9.2 and in figure 9.7. Variants of RTD installation in thermal pockets are given in the table 9.3 and in figures 9.8, 9.9.

Warning! Applying lugs with inclination 45 or 60 °, it is necessary to provide a contact of heat carrier with the bottom part of RTD, where thermosensitive element is located.

The installation place for each RTD included in delivery set is given on the meter's scheme for installation (see the appendix B). The RTD which measures temperature of the heat-carrier (water) should be installed close to FS. The distance between the RTD and the calculator should not exceed 100 m.

The RTD can be installed on the upstream or downstream sections of FS, but installation on the downstream section is preferable. While installing the RTD after FS, the distance between the bush and FS should be not less than 5 DN and at installation before FS - not less than 10 DN.

After bush welding, it is necessary to process its thread by tap M10x1.5 or M16x1.5 (depending on bush type).

While installing the RTD with inclination 45° or 60°, it is necessary to drill 10 mm hole (16 mm for a thermal pocket) and to saw up to a necessary oval depending on thickness of a pipe wall (see figure 9.6 and figure 9.8).

The sealing surface of the bush should be protected from splashes of the fused metal during welding.

Before application of sealing gasket (fluoroplastic ring) a sealing surface of the bush should be greased.

While screwing the RTD in the bush, the force put to a wrench of 200 mm length, should be no more than 5 kg and provide hermetic seal. The deformation of fluoroplastic gasket in the gap between sealing surfaces of RTD and the bush is not permitted.

After final installation of RTD in the pipeline, the bush and an external metal part of RTD should be heat-insulated from an environment.

Before screwing the RTD in the thermal pocket it is necessary to be convinced of cleanliness of a thermal pocket and to fill it on 1/8 of volume with high-temperature silicon lubricant of any type.

The soldering scheme for RTD connectors is indicated in the Appendix G.

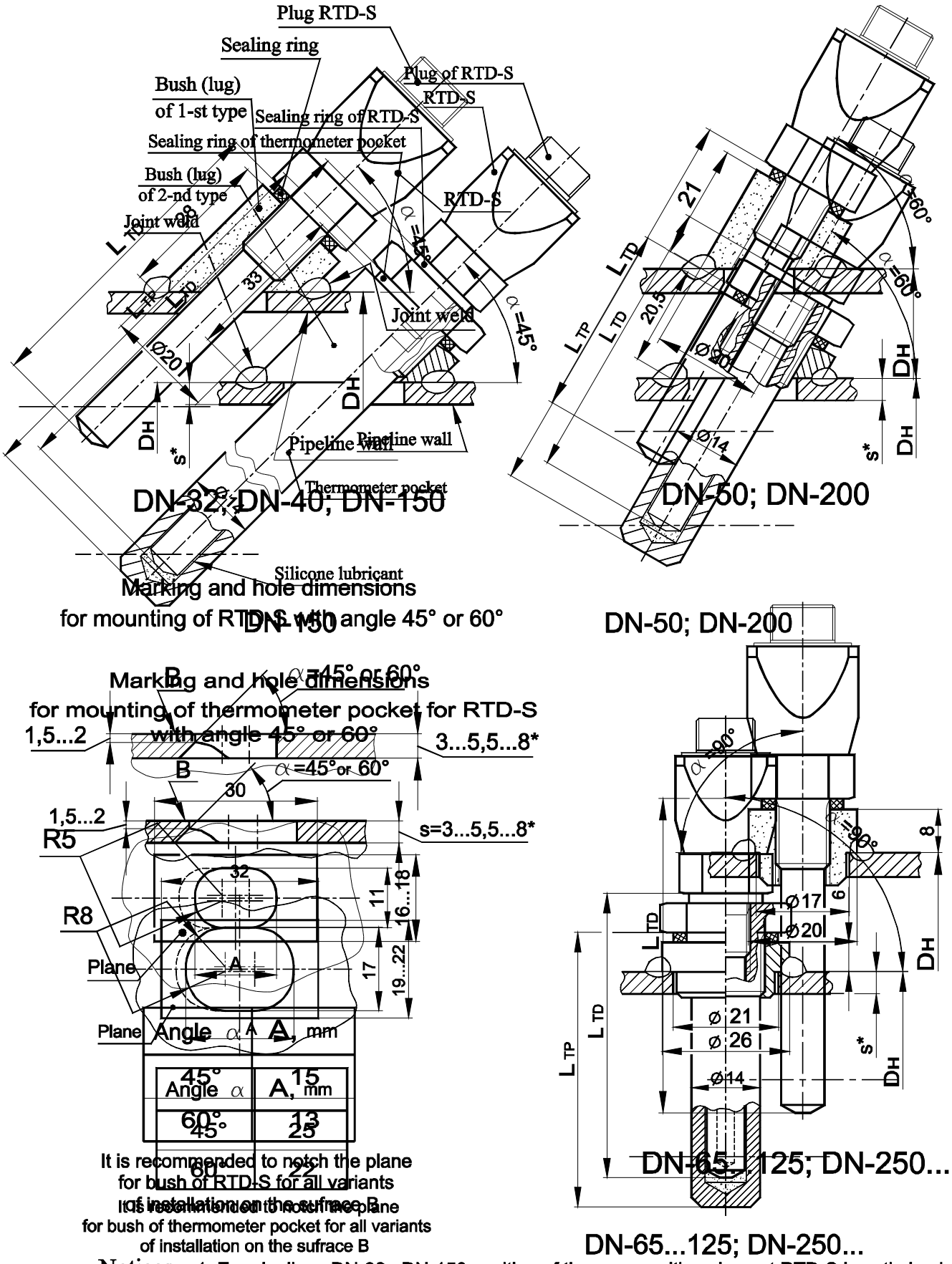
Table 9.2

DN, mm	Configuration of RTD, nominal length (L_{TD}, mm), type	Configuration variants for bushes of first type (internal thread of bushes M10x1.5)		Angle of inclination
		Labeling	Marking	
32	SMP.405212.001-03 L_{RTD}=58; type 4	SMP.723144.007	1	45°
50		SMP.723144.008	2	60°
65		SMP.723144.009	3	90°
80				
100	SMP.405212.001-01 L_{RTD}=80; type 2			
125				
150	SMP.405212.001-02 L_{RTD}=150; type 3	SMP.723144.007	1	45°
200		SMP.723144.008	2	60°
≥250		SMP.723144.009	3	90°

Table 9.3

DN, mm	Configuration of thermal pocket, nominal length (L_{TP}), mm; nominal length of RTD (L_{TD}), mm	Configuration variants for bushes of second type (internal thread of bushes M16x1.5)		Angle of inclination
		Labeling	Marking	
50	SMP.753137.002-03 L_{TP}=56; L_{RTD}=58	SMP.723144.008-01	5	60°
65		SMP.723144.009-01	6	90°
80				
100	SMP.753137.002-01 L_{TP}=78.5; L_{RTD}=80			
125				
150	SMP.302634.002 L_{TP}=148; L_{RTD}=150	SMP.723144.007-01	4	45°
200		SMP.723144.008-01	5	60°
≥250		SMP.723144.009-01	6	90°

The RTD of type 5 and 6 installation is possible only in the thermal pocket.



Notices. 1. For pipelines DN-32...DN-150 position of thermo-sensitive element RTD-S is optimised relatively water and gas pipelines.

2. It is necessary to mount a reamer at installation of RTD-S on pipelines with nominal diameter under DN-50.

Figure 9.6 Installation of RTD-S of type 2, 3 and 4 without thermal pocket

Figure 9.7 Installation of RTD-S of type 2, 3 and 4 with thermal pocket

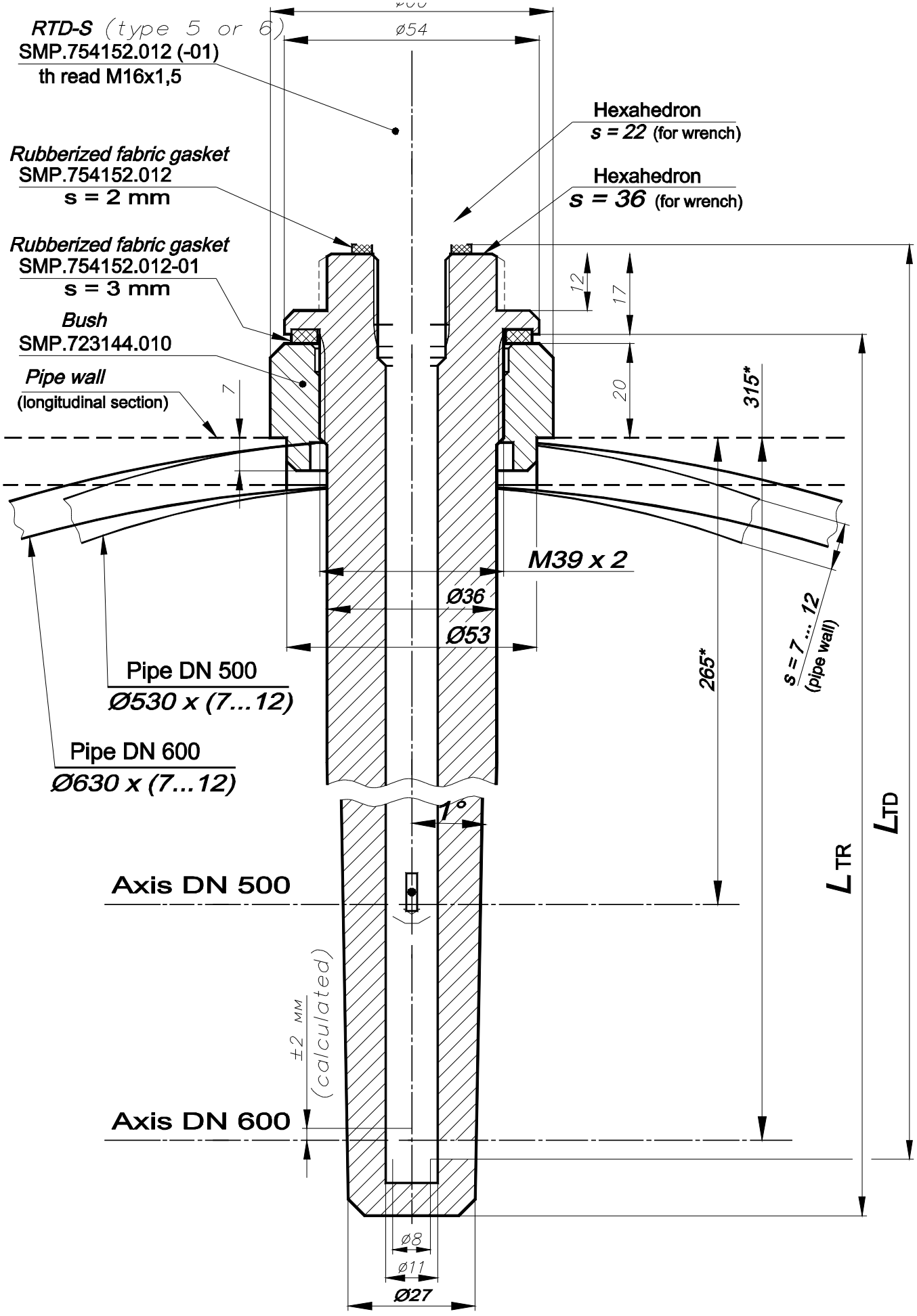


Figure 9.8 Installation of RTD-S of type 5 and 6 with thermal pocket

9.5.4 Installation of pressure sensors

Pressure sensors are installed strictly in vertical position. The scheme of installation is represented in the appendix H.

Application of pressure intake devices is obligatory!

9.5.5 Mounting of the calculator

The Calculator SMP.408843.003 can be mounted in horizontal position (on the table, stand or shelf) or in vertical position (on the wall or in device enclosure).

For mounting the calculator special accessories in delivery complete set are provided. The mounting scheme is given in the appendix D.

The grounding of the calculator should be strictly connected with grounding of a premise in which the device is installed.

9.5.6 Cabling

After installation of all meter components their bond by means of the connecting cables from the delivery complete set is made in following sequence:

1) cabling;
2) cable connection to the calculator, RTD and ultrasonic flow sensors.

9.5.7 Cabling is carried out under following requirements:

— cable mounting should exclude a possibility of its contact with pipelines and other elements if their temperature is below a minus 40 C or above 70 C;
— cable protection against mechanical damages should be carried out by cable grooming in pipes, hoses, ducts, etc. Cable grooming for one meter in one protective housing is permitted;
— cable grooming of two and more meters should be provided in the protective housings separated from each other on a distance not less than 5 cm for prevention of mutual electromagnetic inductions.
— after cable grooming it is necessary to make their connection to meter components considering marks of cables.

WARNING!

- **Grooming of connecting cables near power supply lines or in their (power lines) protective housings is forbidden.**
- **If the meter has 24 or 36 V power supply then arrangement of the calculator should exclude an opportunity of accidental device connection to 220V power supply.**

9.5.8 Cable connection to the calculator and to all sensors should be carried out as follows:

— define ‘switch’ positions on connectors;
— accurately, without appreciable effort plug connectors. Mutual rotation is not permitted;
— a sleeve nut should be twisted at the end.

While connecting sensors to jacks it is necessary to strictly follow the marks on device cable and flow sensor cable outputs.

Table 9.4 Compliance of marking on communication lines with marking on connected to them flow sensor cable outlets for meters with single-beam FS.

Cable function (connected unit)	Marking on device cable	Marking on flow sensor cable outlets main (duplicate) and their arrangement relative to flow			
		For modification M1		For modification M2	
		Marking	Arrangement	Marking	Arrangement
FlS1 of channel 1	11	11 (11p)	First downstream	11 (11p)	n/a
FlS2 of channel 1	12	12 (12p)	Second downstream	11 (11p)	
FlS1 channel 2 (FlS3)	21	21 (21p)	First downstream	22 (22p)	
FlS2 channel 2 (FlS4)	22	22 (22p)	Second downstream	22 (22p)	

Table 9.5 Compliance of marking on communication lines with marking on connected to them flow sensor cable outlets for meters with two-beam FS.

Cable function (connected unit)	Marking on device cable	Marking on flow sensor cable outlets main (duplicate) and their arrangement relative to flow	
		Marking of flow sensor, Main (duplicate)	Marking of the bend, Main (duplicate)
FlS1 beam 1	11	11 (11p)	1 (5)
FlS2 beam 1	12	12 (12p)	2 (6)
FlS1 beam 2 (FlS3)	21	21 (21p)	3 (7)
FlS2 beam 2 (FlS4)	22	22 (22p)	4 (8)

Table 9.6 Marking of device cable communication lines for connection of temperature sensors RTD, pressure sensors PT and external devices.

Cable function (connected unit)	Marking on device cable	Cable function (connected unit)	Marking on device cable
TS1	31	PT1	41
TS2	32	PT2	42
TS3	33	Interface RS232	51
TS4	34	Analogue outputs	61
TS5	35	Interface RS485	71
TS6	36		

Structural and basic schemes of device cable are given in the appendix F.

The calculator should be powered by three-pole socket.

9.5.9 CAUTION! IT IS FORBIDDEN:

1 To break the procedure of cable connection according to marking (tables 9.4 – 9.6).

2 To swap around RTD of temperature sensors TS1, TS2, TS3, TS4, TS5, TS6 (see the Appendix B) and pressure sensors PT1 and PT2.

3 To increase or shorten length of cables of ultrasonic flow sensors FlS.

4 To apply FS, RTD, ultrasonic flow sensors FlS and calculators from different delivery sets.

5 Cable twisting, kinking and sharp bends at connection to FlS is not permitted.

CAUTION!!!

If it was required to make welding during device commissioning, the meter should be switched off and device cable should be disconnected from the calculator housing. Otherwise the meter can be damaged.

10 Setting-up procedures

10.1 Before powering up the calculator, please check up the conformity of a power supply voltage (specified on the calculator) to a real voltage.

10.2 If meters operate together with the external equipment (a personal computer, a printer) they should be connected in accordance with the proper operational instructions.

10.3 Connect a power cable to a three-pole socket.

10.4 For comfortable work with the device (after its purchase and before installation) and for check of device working capacity together with ultrasonic flow sensors it is necessary:

1) Assemble a flow meter section with rubber or paronite gasket (thickness of 1-2 mm) and technological cap at the end face, install it vertically, fix flow sensors, and completely fill FS with water.

2) Check up all items in a mode **«Indication of main parameters»**, check up all items in a mode **"Check"** and also it is obligatory to provide zero setting in a mode **"Setup"** to correctly repeat this operation while installing device on the object (the description of operating modes is also given in Chapter 11).

10.5 **While installing device on the real object** it is necessary to fill with water the pipeline with installed flow measurement section. Run through FS the heat-carrier (water) with increased volumetric flow rate during 10 minutes. Be convinced of no leakage in places, where meter components are installed, and no error messages on the digital display of the calculator. The list of these messages is resulted in Chapter 13.

10.6 Accomplish mentioned hereinafter actions in a mode **«Setup»**.
To login in a mode **"Setup"** see instructions described in item 11.2.4, the order of menu access in a mode **"Setup"** is described in item 11.2.5, and also in Appendix E

In a mode **"Setup"**:

- set hydraulic zero for the channel of volume measurement;
- input the temperature value of cold water into calculator memory (only for configuration 4);
- set the proper units;
- set a proper archiving format for the heat-carrier (water) volume data ;
- input the pressure value of the heat-carrier in supply and return pipelines into calculator memory;
- reset all integral meter parameters.

Warning!

Zero setting should be provided for all FS of DN less than 400 mm. For FS of DN400 and more zero setting isn't required. **For FS, which nominal bore isn't more than 400 mm cable connection to flow sensors should be done strictly with marking on FlS and corresponding cable.**

For zero setting following actions should be done:

— Zero setting should be carried out not earlier than in 30 minutes after powering up of the meter.
— Cut off a heat-carrier (water) flow, thus FS should remain completely filled with heat-carrier (water).
— Provide zero setting according to menu item “Setup”.

In case of operation failure or wrong zero setting the measurement error increases and can exceed permissible value. Reset of device readings at its commissioning is blocked, if setting of hydraulic zero is not made. Detailed information about zero setting is given in Appendix J “How to set hydraulic zero”.

If during meter startup a reset of device readings was not provided, a proper warning will be displayed on the indicator.

After ending of the above-stated operations meters are ready for functioning and set in a mode **«Indication of main parameters»**. Temperature values on the device indicator measured by first two temperature sensors TS1 and TS2 are displayed.

10.7 To switch off the meter a 3-pole plug should be disconnected from a socket.

WARNING!

— While in service it is forbidden to disconnect sensors, to change arrangement of sensors (to prevent such not authorized actions **a mechanical socket sealing** of all FlS, TS, PT is stipulated), to switch off the calculator, to install meters on the pipeline with incomplete (partial) water filling of FS or on the pipeline supplying the heat-carrier in steam condition. In all above-stated cases (except for device switching off) the heat meter will register failure operating time, which is subtracted from the time of the heat-carrier control. Power off time (switching-off time) isn’t considered during failure operating and would be displayed in a mode **«Indication of additional parameters»** (see item 11.2.2) .
— If the heat-carrier was cut off for a long time (interheating period, repair of heat system, etc.) and it had led to occurrence of stagnations in the pipeline (drains, a rust, bubbles, etc.) it is recommended to switch-off the device or to provide the guaranteed absence of the heat-carrier in a flow measuring section (to block pipeline valves and to drain the rests of water by means of the drain valve - see figure 9.1).
— Scum on internal FS walls reduces the real FS diameter and can lead to overestimation of water and heat flow rate readings. Therefore it is necessary to provide maintenance service of meter every two years (see Chapter 12).
— During each operation cycle (1 - 2 seconds) the heat meter carries out self-diagnostics of a technical condition by several criteria. In case of measurement section failures, breakage of flow (temperature) sensor cables, absence of the heat-carrier, etc., storage of integral parameters (heat-carrier volume and mass, heat energy and non-failure operating time) is discontinued and the error message is appeared (see Chapter 13).

11 The operating procedure

11.1 Requirements to the personnel.

The maintenance personnel should be acquainted with present OM completely. The work with meters is permitted to persons acquainted with safety regulations on electrical facilities.

11.2 **Structure of the menu** of control of the meter.

Control of the meter (a readout and specification of operating mode and meter parameters) is carried out by means of proper menu item selection.

Menu of control of the meter consists of a group of message lines (menu items), serially displayed on the meter indicator.

Use of the menu (switching of items) allows to get the information about measured parameters of the heat-carrier, parameters of the meter and also to carry out meter verification and to modify meter parameters by results of its metrological performance control.

Selection of menu items is carried out by means of pressing buttons on the calculator. Sequence of operations to select the certain menu item and to input parameter value or to select a parameter from the list is given in the Appendix E.

All measured quantities, meter parameters and commands for meter control are combined in some sections - **control modes** of the meter.

Some service modes ('Setup', 'Verification') are protected from non-authorized access by the password.

The meter menu structure is resulted in the table 11.1, and its graphic representation - in figure 11.1.

11.2.1 '**Indication of main parameters'** Mode.

The arrangement of items in a mode 'Indication of main parameters' is resulted in chapter 1 of the table 11.1 and in figure 11.1. The list and the content of items are resulted in the table 11.2.

The order of running through the menu in a mode **'Indication of main parameters'** is resulted in Appendix E, in figure E-1.

The device switches to mode **'Indication of main parameters'** after power up, after setting-up in a mode **'Setup'** (see chapter 10 of OM), after ending of operating in service modes ('**Check'**, **'Verification'**) and also at automatic switching to mode **'Indication of main parameters'**.

Depending on meter configuration the proper measured parameters, which meet to a given configuration, are displayed on the calculator indicator.

Table 11.1

How to enter the menu section	Section*	Name of menu item	Section assignment
Power switching-on	1	Mode of indication of main parameters	Indication of main measured parameters and current time
Switch to item 'Select mode'	2	Selection of a mode	Selection of a mode in a mode list

How to enter the menu section	Section*	Name of menu item	Section assignment
Selection of a mode	2.1	Additional parameters	Indication of heat-carrier mass, time of correct work and power off time
	2.2	Check	Indication of heat meter parameters, number of entries into service modes and print out of archives
	2.3	Setup	Accomplishment of proper operations at heat meter commissioning
	2.5	Verification	Performance of proper operations during verification (the control of metrological performance)
	2.6	MDM/REG**	MDM/REG setup. The description of modes for built-in unit MDM/REG you can find in a detached manual.
	2.7	Credit prolongation**	Input a password for credit prolongation. It is indicated only when mode 'Credit' is active.

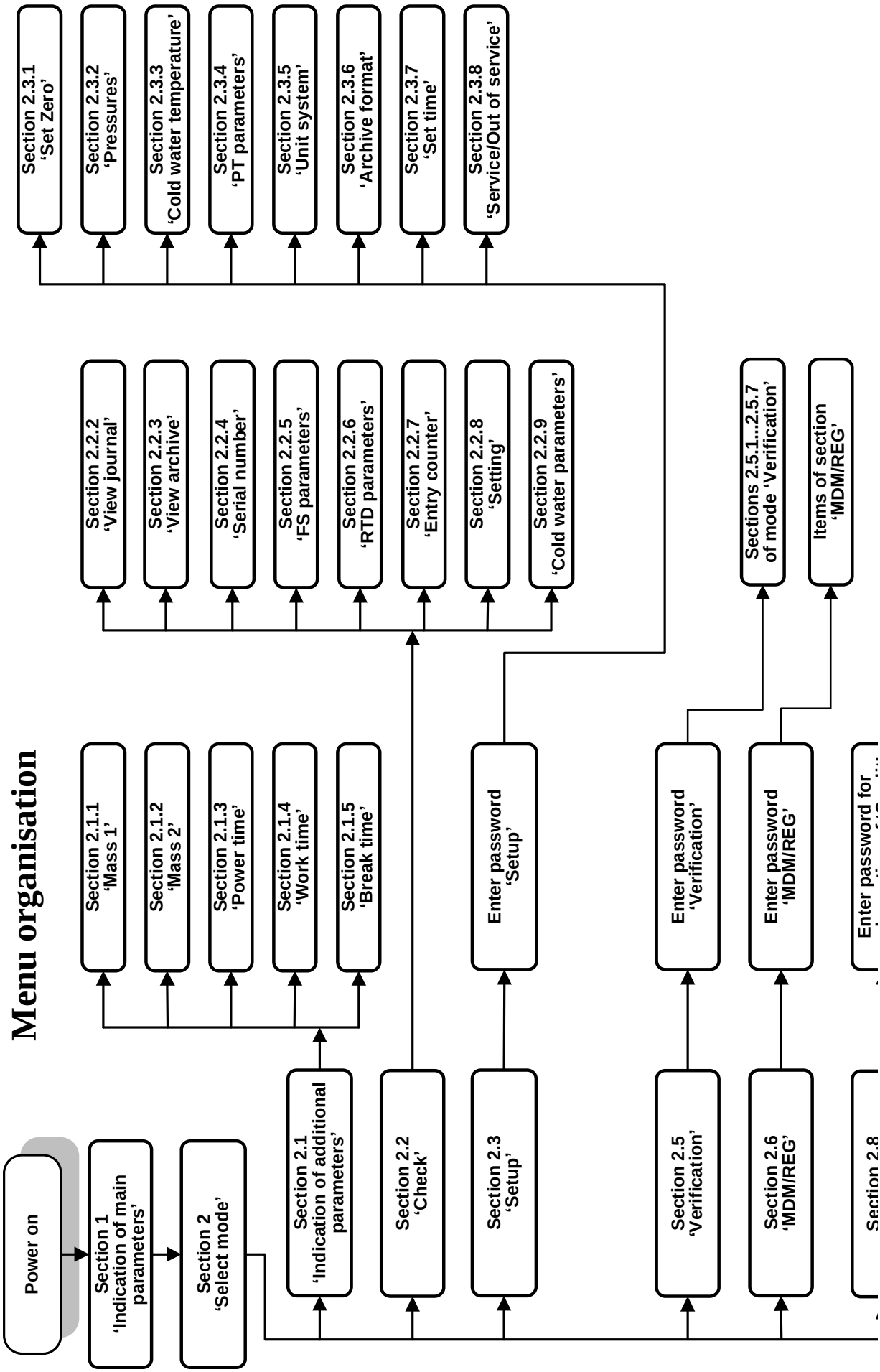

Menu organisation
Power on
Section 1 'Indication of main parameters'
Section 2 'Select mode'
Section 2.1 'Indication of additional parameters'
Section 2.2 'Check'
Section 2.3 'Setup'
Section 2.5 'Verification'
Section 2.6 'MDM/REG'
Section 2.1.1 'Mass 1'
Section 2.1.2 'Mass 2'
Section 2.1.3 'Power time'
Section 2.1.4 'Work time'
Section 2.1.5 'Break time'
Enter password 'Setup'
Enter password 'Verification'
Enter password 'MDM/REG'
Sections 2.5.1...2.5.7 of mode 'Verification'
Items of section 'MDM/REG'
Section 2.2.2 'View journal'
Section 2.2.3 'View archive'
Section 2.2.4 'Serial number'
Section 2.2.5 'FS parameters'
Section 2.2.6 'RTD parameters'
Section 2.2.7 'Entry counter'
Section 2.2.8 'Setting'
Section 2.2.9 'Cold water parameters'
Section 2.3.1 'Set Zero'
Section 2.3.2 'Pressures'
Section 2.3.3 'Cold water temperature'
Section 2.3.4 'PT parameters'
Section 2.3.5 'Unit system'
Section 2.3.6 'Archive format'
Section 2.3.7 'Set time'
Section 2.3.8 'Service/Out of service'

Fig. 11.1

Table 11.2

Menu item*	Name of menu item	Notes
1.1	Temperature t1, °C Temperature t2, °C	Indication of temperatures, measured by temperature sensors TS1 and TS2
1.2	Temperature t3, °C Temperature t4, °C	Indication of temperatures, measured by temperature sensors TS3 and TS4
1.3	Temperature t5, °C Temperature t6, °C	Indication of temperatures, measured by temperature sensors TS5 and TS6
1.4	Flow rate1, m^3/h Flow rate 2, m^3/h	Indication of heat-carrier (water) volumetric flow rates in FS1 and FS2.
1.5	Pressure P1, kgf/cm^2 Pressure P2, kgf/cm^2	Indication of overpressure, measured by pressure transducers PT1 and PT2.
1.6	Volume 1, m^3 Volume 2, m^3	Indication of heat-carrier (water) volume in FS1 and FS2.
1.7	Mass leak, ton/hour	Indication of the calculated mass leak of the heat-carrier (water) (only for configurations 4, 5, 7),
1.8	Heat power, Gcal/h	Indication of the heat power
1.9	Heat energy 1, Gcal Heat energy 2, Gcal	Indication of the heat energy for FS1 and FS2 (or total heat energy for configurations 4, 7, 9)
1.10	Current time	Indication of astronomical time and current data

* The numerical item designation accepted within this OM for the description of the menu structure (it is not displayed on the indicator of the calculator).

11.2.2 **'Indication of additional parameters'** Mode.

The arrangement of items in a mode 'Indication of additional parameters' is resulted in item 2.1 of the table 11.1 and in figure 11.1. The list and the content of items are resulted in the table 11.3.

The order of running through the menu in a mode **'Indication of additional parameters'** is resulted in Appendix E, in figure E-2.

Table 11.3

Menu item	Name of menu item	Explanation
2.1.1	Mass 1, ton	Indication of heat-carrier (water) mass in FS1 and FS2.
2.1.2	Mass 2, ton	
2.1.3	Power time, h	Indication of power on time
2.1.4	Work time, h	Indication of correct work time (work time)
2.1.5	Break time, h	Indication of power off time (break time)

11.2.3 At occurrence of worst-case situations in modes 'Indication of main parameters' and 'Indication of additional parameters' **a code and character of malfunction** (see Chapter 13) are displayed on the device indicator.

11.2.4 **'Check'** Mode.

The arrangement of items in a mode '**Check'** is resulted in item 2.2 of the table 11.1 and in figure 11.1. The list and the content of items are resulted in table 11.4.

The order of running through the menu in mode **'Check'** is resulted in Appendix E, in figures E-3…E-6.

The mode **'Check'** provides for revision of archive data and events journal (operator actions), indication of parameters, which are necessary for control, adjustment of device indicator contrast and adjustment of a bitrate within interface RS-232C. The mode **'Check'** does not interrupt measuring process and can be used both the energy-supervisor, and the user (see table 11.4.).

Table 11.4

Menu item	Name of menu item	Explanation
2.2.1	n/a	n/a
2.2.2	View journal	Displaying of event journal
2.2.3	View archive	Displaying of hourly, daily error archives with error codes
2.2.4	Serial number	Indication of calculating unit number given by the manufacturer, configuration and the program version for the meter
2.2.5	FS parameters	Indication of diameter values, conversion ratios and distances between transmitters of FS1 and FS2, resulted in Chapter 17 of OM.
2.2.6	RTD parameters	Indication of temperature coefficients of NSC RTD (coefficients Kdl1, Krc1, Kdl2, Krc2, Kdl3, Krc3, Kdl4, Krc4), set by the manufacturer (see Chapter 17 of OM).
2.2.7	Entry counter	Indication of number of entries in modes **'Setup' and 'Verification'**
2.2.8	Setting	Step adjustment of picture contrast on the calculator indicator and a bitrate for RS-232 is carried out
2.2.9	Cold water parameters*	Indication of temperature and pressure in cold water supply pipeline (configurations 4, 7, 9)
*indicated only for proper meter configuration		

Storage of the archival information begins after reset of integral parameters during meter startup. Hourly archive history is 70 days, daily archive history is 1 year. It means, that the archive contains stored data for last 70 (365) days preceding a current hour.

All users' actions carried out in modes 'Setup' and 'Verification' are registered in the event journal. They can affect the measuring result.

Calculator carries out automatic switch to summer and winter time.

Automatic switching to summer time can be turned off by user in the mode 'Setup'.

11.2.5 Description of the mode **'Enter password'.**

Entry into service modes **'Setup' and 'Verification'** is permitted only after entering the proper passwords **to avoid non-authorized access** to parameters saved in calculator memory. Password input is requested after the user has chosen a proper mode in the menu.

The manufacturer set the following **standard passwords for service modes** (see table 11.5) at device shipment:

Table 11.5

MODE	STANDARD PASSWORD
'Setup'	25205757
'Verification'	31415926

On customer's demand the manufacturer can set INDIVIDUAL PASSWORDS for service modes that is equivalent to additional ELECTRONIC SEALING of the calculating unit and provides inaccessibility of unauthorized users to the saved up measuring information.

The password is represented by 8-digit integer number, which is necessary for getting access to one of service modes.

Symbols * on the indicator mark bits into which it is necessary to input password digits.

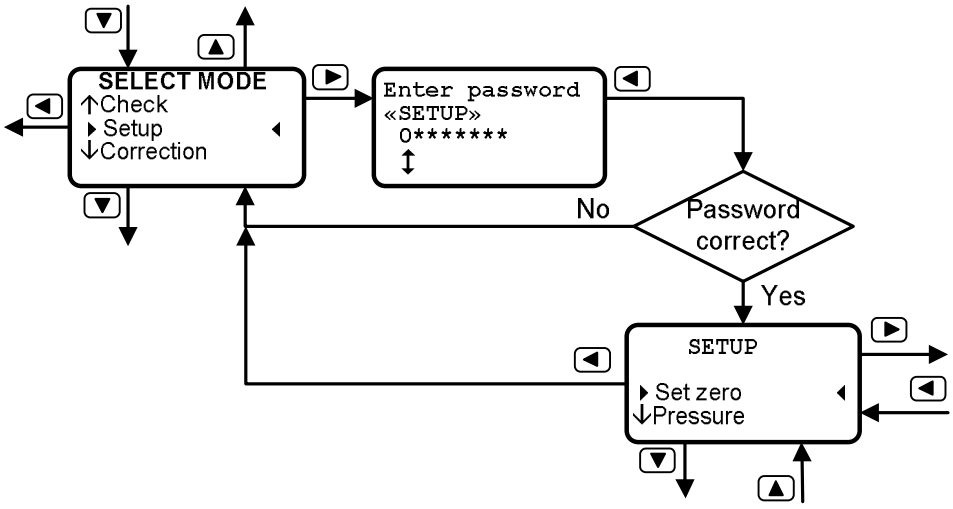
Non-masked (open) value of an input digit is displayed only in that bit, in which input of its values (editing) is made.

Pressing the button ▶ ("To the right") moves the cursor on one bit to the right, allowing to change separate bits of the password.

Pressing buttons ▲ and ▼ («Up» and «Down») leads to a change of the edited digit.

Pressing the button ◀ («To the left») means ending of password input.

If during 10 minutes there was no pressing of any button the meter is switched from a mode 'Enter password' to mode 'Indication of main parameters'.



In figure 11.2 the example of password input for entry in a mode 'Setup' is given.

Figure 11.2

11.2.6 '**Setup'** Mode.

The arrangement of items in a mode 'Setup" is given in item 2.3 of table 11.1 and in figure 11.1. The list and the contents of items are resulted in table 11.6.

The order of running through the menu in a mode **'Setup'** is resulted in appendix E, in figures E-7…E-12.

The **'Setup'** mode is used by consumer during meter commissioning for hydraulic zero setting in volume measurement channels, setting of units, input of necessary parameters of 1-st and 2-nd channels and also for total device reset (see table 11.6).

Table 11.6

Menu item	Name of menu item	Explanation
2.3.1	Set zero	Setting of hydraulic zero, which is necessary for device commissioning
2.3.2	Pressures	Input of internal pressure values in supply and return pipelines for channels 1 and 2
2.3.3	Cold water temperatures*	Input of cold water temperature value (only for configuration 4)
2.3.4	PT parameters *	Enter the number of used PT and their parameters
2.3.5	Unit system**	Setting of unit system (CGS or SI)
2.3.6	Archive format**	Archive format for heat-carrier flow rate is selected (by volume or by mass).
2.3.7	Set time**	Input of current values: year, month, day of week, hours, minutes
2.3.8	Service	Total nulling of all stored parameters and archive (can be seen only after shipment or after 'Out of service' mode)
2.3.9	Out of service	Editing of meter parameters is permitted (can be seen only after 'Service')
* indicated only at proper meter configuration		

The notice. Items, marked by ** are accessible only after 'Out of service'.

11.2.7 **'Verification'** Mode.

The **'Verification'** mode is intended for estimation of measurement errors and calculation errors of some basic meter metrological parameters and also for verification of correctness of their indication.

The **'Verification'** mode is used for automation of periodic verification of heat meters. Verification can be carried out only by manufacturer or his authorized representative with participation of state verification officer.

This mode has been specified in verification instruction.

THE NOTICE: While entering **'Verification'** mode the saved up integrated parameters are not misrepresented. To see number of entries into **'Verification'** mode, switch to '**Check'** mode.

11.2.8 Additional modes.

11.2.8.1 'MDM/REG' Mode.

It is intended to set parameters of the built-in MDM/REG unit, notably parameters of communication for the MDM unit and parameters of linear and threshold outputs for the REG unit including parameters of regulators (if any from linear outputs is used for regulation).

The arrangement of items in the ‘MDM/REG’ mode is resulted in item 2.6 of the table 11.1 and in figure 11.1. The list and the content of items are resulted in special manual if this mode is ordered by consumer.

11.2.8.2 ‘Credit prolongation’.

It is intended to input a password for credit prolongation.

11.3 Malfunction diagnosis.

The calculator carries out diagnostics of malfunctions and gives out malfunction messages on the indicator. The detailed description of the device functioning in this mode is resulted in Chapter 13 of OM.

12 Servicing

12.1 The Instruction to the representative of inspecting service

12.1.1 The SVTU-10M heat flow meter is protected from consumer intervention as well as intervention of heat supply organization. Any changes of a heat meter parameters can be carried out only in **'Setup' and 'Verification' service** modes. To except a non-authorized access into device functioning process and prevent possible attempts to change any device constants (calibration factors of thermoresistor Kdl and Krc, conversion ratio on flow rate, geometrical parameters of a flow meter section), the fact of login or running through these modes is fixed in the **'Check'** mode (see appendix E). **The opportunity to check inputs in the specified modes** is equivalent to a mechanical sealing (i.e. it substitutes mastic seals, branded labels, etc.), so it is **electronic way of calculator sealing**. Therefore the basic attention should be paid to the number of entries into **service** modes. Difference of this number from the recorded one at the moment of device commissioning (release date according to the certificate) should be considered as damaging of the seal installed by inspecting organization. The possibility of mechanical sealing of the calculating unit with the use of sealing cups with holes on device case is stipulated.

12.1.2 In doubts of heat meter correct installation or operation it is necessary to enter into the **'Check'** mode and to compare correctness of the entered values for RTD temperature coefficients, FS exact diameters, distances between flow sensor transmitters and FS conversion ratios to the data resulted in Chapter 17 'Parameters and characteristics of meter components'. Thus compared values can differ in limits, which are not exceeding units mentioned in Chapter 17 of this OM.

12.1.3 It is necessary to consider, that a heat meter commissioning begins with **reset** (nulling) of its integrated indications (the saved up measuring data). Reset of indications also should be carried out after meter repair or verification.

12.1.4 Difference between power on time and time of correct work means that a heat meter operated incorrectly (switching-off, breakage or short circuit of sensor cables, absence of the heat-carrier, etc.). Therefore sealing of flow sensors or their connectors is not obligatory. However, the possibility of mechanical sealing for flow sensors and their connectors with a use of proper holes in clamping nuts of FlS and connector cases is stipulated.

12.1.5 To except a non-authorized influence on RTD parameters and so on temperature measurement accuracy it is necessary to mechanically seal up the temperature sensor using a hole in RTD case.

12.2 Maintenance service is carried out by the representative of service organization. During servicing it is necessary to carry out the security measures given in Chapter 8.

12.3 Meters are put to two servicing types: #1 and #2.

12.4 **Servicing #1** is carried out on a meter operation place twice a year and includes external examination and check of working capacity.

Check visually:

— no leak in places of meter installation;
— reliability of contact joints;
— no mechanical damages on plastic details;

— safe isolation of connecting cables;
— measuring data output in accordance with items 11.2.1 and 11.2.2.

After ending of heating season it is necessary to make cleaning of flow sensor surfaces using washing-up liquids, weak solutions of alkalis or acids (without mechanical cleaning). If heat meter was out of service for a long period of time it is recommended two ways: to switch-off the device or to provide the guaranteed absence of the heat-carrier in a flow measurement section.

12.5 **Servicing #2** of meters is carried out annually.
At servicing #2 following operations should be carried out:
— operations, provided by servicing #1;
— dismantling and cleaning of FS according to item 12.5.1;
— dismantling and cleaning of RTD.

12.5.1 Dismantling and cleaning of FS is carried out in the following way:
— to dismantle ultrasonic flow sensors;
— to detach FS from the pipeline;
— to carry out external examination of FS and, if necessary, to clean mechanically its internal surface from sediment;
— to wash out internal FS surface by a solution of a synthetic washing-up liquid of any type, and then by water.

12.6 Meters are presented for verification after servicing #2. Calibration interval is 4 years. Calculator, ultrasonic FlS, temperature sensors, flow measuring sections are presented for verification.

Metrological verification of meter modification M2 can be carried out according to ‘no water’ method using flow rate simulator IMR-01 (see table 4.1 of verification method SMP.407251.003 И2).

The test for flow meters (if necessary) can be carried out applying certified flow measurement sections.
The test for meter modification M1, which includes FS with nominal diameter more than DN 100, is carried out applying certified flow measurement sections of DN 100.

13 Typical faultinesses and methods of their elimination

While in operation, the meter constantly checks working capacity both the internal units and the sensors (of flow rate, temperature, etc.) connected to the meter.

Diagnosed errors are subdivided into groups according to a priority (importance for realization of normal measurement). The number of group less, the error importance is more. The error code includes its number and number of the measurement channel, in which there was an error.

Error displayed on the indicator looks as follows (example):

Err. 1.3.1
TS1 short

Here 1.3.1 is error code, which consists of group (first digit), error number (second digit) and measurement channel number (third digit). In this case measurement channel number is a number of temperature sensor. One error is shown on two indicator lines. So, two different errors can be displayed simultaneously (indicator has 4 lines).

As it was specified above, the number of error group is less, the priority of error is higher. Surely most significant errors are system errors. These errors of the internal meter equipment make meter functioning impossible. So none of the parameters are measured and stored. Such errors are displayed on the indicator as follows (example):

System
error 02

Number means an error type. System errors are registered in the event journal with some text decoding, if possible.

In case of system error the meter should be delivered to manufacturer for repair.

13.1 Error group «**0**».

In group «0» following errors are included:

— «**0.1.0**» - Error of flow measurement section. Flow measurement in both channels is impossible.
— «**0.2.0**» - Error of ADC. Temperature measurement in all channels is impossible.
— «**0.3.0**» - Error of communication with MDM. It does not affect measurements and calculations. It makes impossible data collection through external communication lines. The REG Unit (if it is installed) does not display the information on analog and switch outputs (including regulating channels).

13.2 Error group «**1**».

This group includes the errors referring to temperature measurement (the sign «x» specifies number of the channel):

— «**1.1.0**» - break of one or some TS from the set TS1...TS3.
— «**1.2.0**» - break of one or some TS from the set TS4...TS6.
— «**1.3.x**» - fault of TSx.
— «**1.4.x**» - TSx is failed. Resistance of mentioned TS is out of specified limits.
— «**1.5.x**» - error of TSx factors. It was an error during *manual* input of calibration factor for mentioned TS. This error can appear after TS calibration and *manual* input of new factor values during meter verification.
— «**1.6.x**» - TSx is below the tolerance. Measured by TS temperature is lower than acceptable one (is lower than -50 C).
— «**1.7.x**» - TSx is over the tolerance. Measured by TS temperature is higher than the maximum (is higher than +150 C).

If TS with an error is taken into flow rate measurement process, then proper flow measurement channel cancels all measurements. If TS is used for heat energy calculation then heat energy is not determined.

13.3 Error group «**2**».

This group includes the errors of pressure measurement (the sign «x» specifies number of the channel):

— «**2.1.x**» - PSx is below the tolerance. Measured pressure is below zero. It can be caused by object conditions (underpressure was created), or with breakage of corresponding PS.

— «**2.2.x**» - PSx is over the tolerance. Measured pressure is above 20 kgf/cm^2. It can be due to the fact of increased pressure on the object and faultiness of PS.

Pressure measurement errors don't affect flow rate measurement and heat energy calculation.

13.4 Error group «**3**».

This group includes the errors referring to flow rate measurement (the sign «x» specifies number of the channel):

— «**3.1.x**» - measurement by FSx. Flow measurement in mentioned FS is impossible. This error can be caused by the fact of:

— faultiness of flow sensors;

— faultiness of flow sensor cable – brake or fault;

— no water in FS.

— «**3.2.x**» - temperature of FSx. Because of malfunction of TS, which measures temperature in specified FS, a flow rate measurement is impossible. This error always takes place with an error of measurement by TS. This error is displayed (and is brought in error archive) to define interrelation between a temperature measurement error and a flow rate measurement error.

— «**3.3.x**» - high speed in FSx. The volumetric flow rate in mentioned FS exceeds maximum value for this FS type more than twice.

If the error has been registered in the flow measurement channel, which is used for heat energy calculations then heat energy is not calculated.

13.5 Error group «**4**».

This group includes the errors referring to heat energy calculation (the sign «x» specifies number of the channel). Here the errors in temperature ratios, which are necessary for heat energy calculation, are analyzed:

— «**4.1.x**» - tret > tsup + 2.5 C. The temperature of the return pipeline exceeds the temperature of supply one more than on 2.5 C. Heat energy calculation is impossible. If excess is in a range: 0 up to 2.5 C, a temperature difference is accepted equal to 0, and the error is not registered.

— «**4.2.x**» - tcw > tsup + 2.5 C. The temperature of cold water exceeds water temperature in supply pipeline more than on 2.5 C. Heat energy calculation is impossible. If excess is in a range: 0 up to 2.5 C, a temperature difference is accepted equal to 0, and the error is not registered.

— «**4.3.x**» - tcw > tret + 2.5 C. The temperature of cold water exceeds water temperature in return pipeline more than on 2.5 C. Heat energy calculation is impossible. If excess is in a range: 0 up to 2.5 C, a temperature difference is accepted equal to 0, and the error is not registered.

— «**4.4.x**» - t_{HWS} > tsup + 2.5 C. The temperature of hot water supply system HWS exceeds water temperature in supply pipeline more than on 2.5 C. Heat energy calculation is impossible. If excess is in a range: 0 up to 2.5 C, a temperature difference is accepted equal to 0, and the error is not registered.

These errors don't affect flow rate and temperature measurements.

In hourly and daily archive printouts there is a value of error appearance duration (Terr) for the first and second flow measurement channels. This value includes the errors referred to flow measurement channel and errors, which lead to impossibility of flow rate measurement. Errors of a flow meter and errors of temperature measurement are included here.

Printouts have a field ‘Error types’, in which presence of certain error type is displayed. In total up to three various types of errors can be displayed within an hour and up to 5 types of errors can be displayed within a day. The error is displayed on printout only if its duration exceeds 1 minute.

Errors are displayed by letters of the Latin alphabet. The certain letter meets to each type of errors:

A – system errors (error group 0);
B – temperature measurement errors (error group 1);
C – flow rate measurement errors (error group 3);
D – pressure measurement errors (error group 2);
E – heat calculation errors (error group 4);

For example, record ‘BD’ means, that there were errors of group 1 and group 2. More detailed information on these errors can be taken in the error archive printout.

In error archive printout the error code in the above described format and duration of this error in hours are mentioned. Within one hour up to 3 polytypic errors can be registered (in archive) and for a day - up to 5 polytypic errors can be registered. If the number of errors is more than it was mentioned, than the most significant errors are stored. For example, the error of one TS can cause some more other errors, so only error of TS will be displayed.

The list of certain faultinesses and methods of their elimination are resulted in table 13.1.

Table 13.1.

Appearance of faultiness	**Possible reason**	**Method of elimination**
1. There is no indication on the display	Breakage of a calculator power cable, or cable is unplugged.	To eliminate a break (to plug a cable)
2. The meter does not react on button pressing	The calculator is faulty	To repair the calculator

The notice: A repair of the calculator is made by specialized manufacturing division.

14 Storing

14.1 Heat meter storing can be made in heated or unheated storehouses.

Meter life cycle:

— in heated storehouse – no more than 10 years;
— in unheated storehouse - no more than 5 years.

14.2 Storage conditions for meters:

in heated storehouse:

— ambient temperature can vary from 0 up to 50 C;

— relative air humidity is up to 80 %, while temperature is 30 C and below without moisture condensation;

in unheated storehouse:

— ambient temperature can vary from minus 5 C up to 50 C;

— relative air humidity is up to 95 %, while temperature is 35 C and below without moisture condensation.

14.3 At long-term storage in unheated storehouse meters should be placed in an additional cover from a polyethylene film.

15 Transportation

15.1 Meters can be transported by all modes of transport. Their packing should provide protection against direct influence of atmospheric precipitation.

While transporting by air transport, meters in packing should be placed in hermetically compartments.

15.2 Transportation conditions:

— ambient temperature:

— for calculator can vary from minus 20 C up to 50 C;

— for FS can vary from minus 50 C up to 50 C;

— relative air humidity is up to 98 %, while temperature is 35 C;

— transport jolty with acceleration 30 m/sec^2 , while frequency varies from 80 up to 120 beats per minute.

15.3 Meters are steady against influence of sinusoidal vibrations, while frequencies vary from 5 up to 35 Hz with amplitude up to 0.35 mm.

15.4 At shipment and unloading it is not permitted to throw meters.

At shipment in vehicle FS and packing box with the calculator should be fixed with the purpose to except any moving.

16 Guarantee of manufacturer

16.1 Manufacturer guarantees that produced heat meters meet to all requirements of their specifications within 48 months from the moment of shipment if the consumer observes the following conditions:

— installation, starting-up and adjustment of a heat meter is made by the organization, which has the manufacturer’s sanction on carrying out given works;

— presence in section 19 of OM a mark of the organization, which has provided installation, starting-up and adjustment of a heat meter;

— conditions of service, transportation and storage meet to requirements in Chapters 8-11, 14 and 15 of present Operating manual.

16.2 Guarantees are extended on defects of meter components in delivery complete set in case of manufacturing defects, defects of materials and componentry.

16.3 Guarantees provide replacement of defective details and check of meter working capacity by manufacturer.

16.4 It is necessary to deliver the faulty device to manufacturer for testing and repair.

16.5 It is not allowed to open the calculating unit (to break seals) before returning the device to manufacturer.

16.6 Guarantees do not provide expenses indemnification for dismantle, return and repeated installation of the device, and also any secondary losses caused by malfunction.

16.7 In case of malfunction identification during a warranty period the consumer should report unsatisfactory condition of the equipment to manufacturer:

SEMPAL Co. LTD

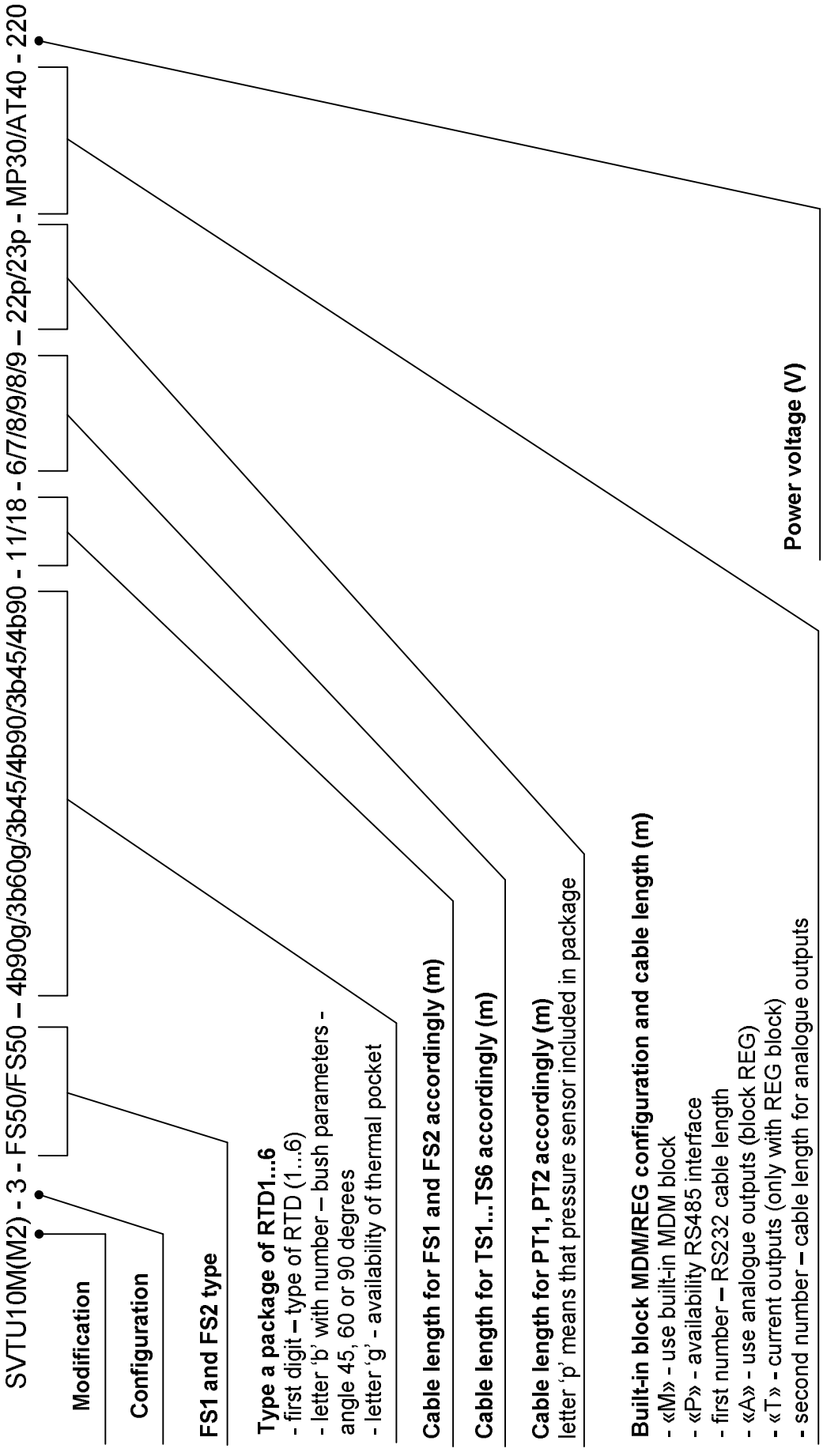
3 Kulibina Str., Kyiv, Ukraine, 03062

Phone/Fax: (+38 044) 239-2197, 239-2198.

16.8 Do not put in claims to a heat meter in following cases:

— installation, starting-up and adjustment have been carried out by organization without manufacturer's license on carrying out of such works;
— damage of seals on the calculating unit;
— the expiration of a warranty period;
— violation of service, storage and transportation regulations stipulated by the operational documentation.

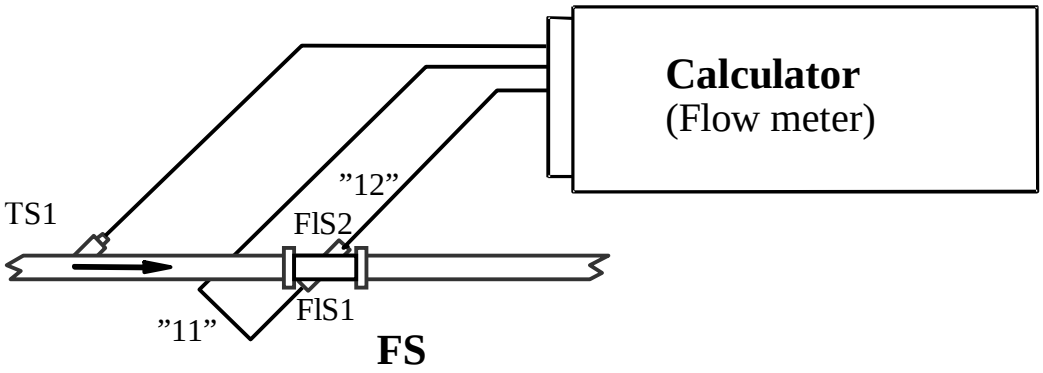
16.9 After ending of a warranty period or loss of warranty service right the manufacturer makes repair of heat meters for a fee.


SVTU10M(M2) - 3 - FS50/FS50 – 4b90g/3b60g/3b45/4b90/3b45/4b90 - 11/18 - 6/7/8/9/8/9 – 22p/23p - MP30/AT40 - 220
Modification
Configuration
FS1 and FS2 type
Type a package of RTD1...6
- first digit – type of RTD (1...6)
- letter 'b' with number – bush parameters - angle 45, 60 or 90 degrees
- letter 'g' - availability of thermal pocket
Cable length for FS1 and FS2 accordingly (m)
Cable length for TS1...TS6 accordingly (m)
Cable length for PT1, PT2 accordingly (m)
letter 'p' means that pressure sensor included in package
Built-in block MDM/REG configuration and cable length (m)
- «M» - use built-in MDM block
- «P» - availability RS485 interface
- first number – RS232 cable length
- «A» - use analogue outputs (block REG)
- «T» - current outputs (only with REG block)
- second number – cable length for analogue outputs
Power voltage (V)

Appendix B

Basic circuits of meter mounting for different configurations

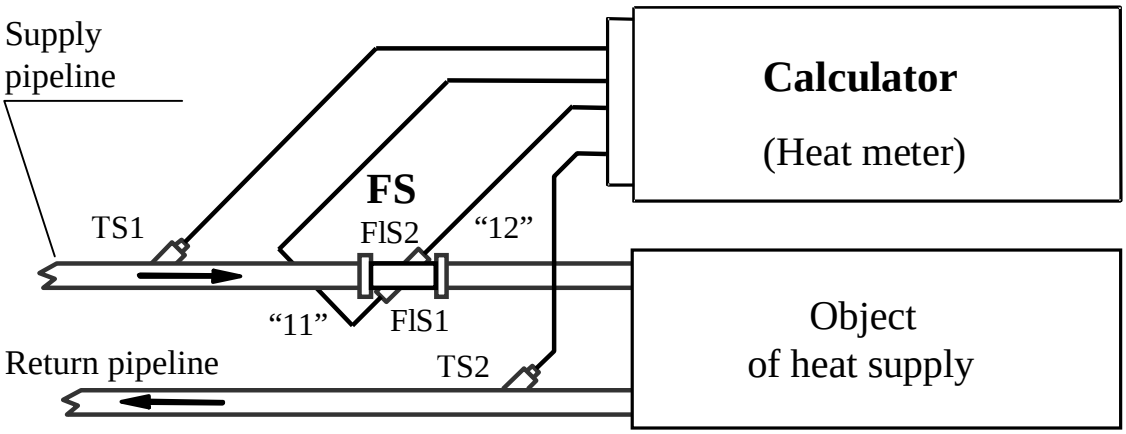
Configuration 1



Basic function is volume measurement

One flow meter

Configuration 2

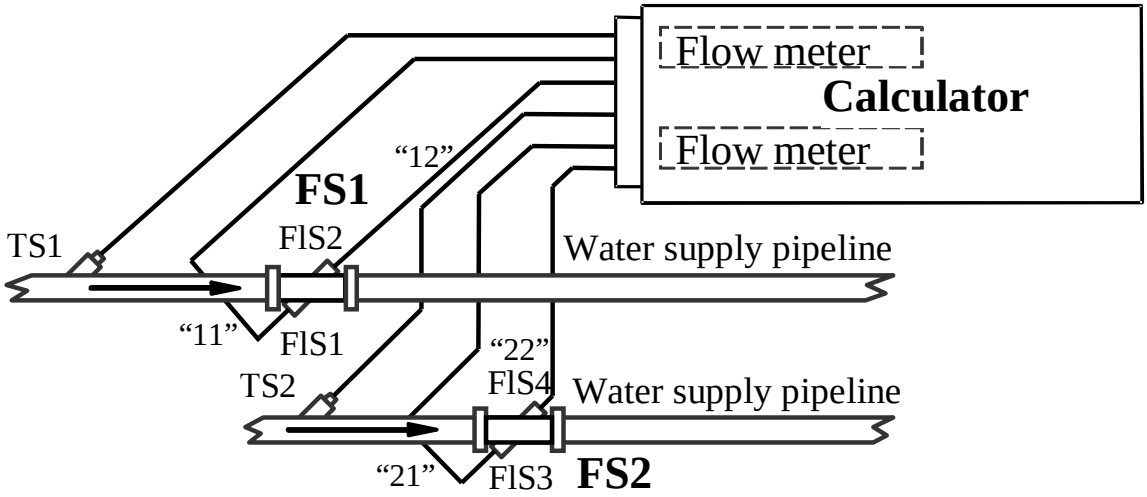


Basic function is heat energy measurement

Heat meter for closed heat supply system

The notice. Numeration of flow sensors and marking of cables are indicated according to the table 9.3.

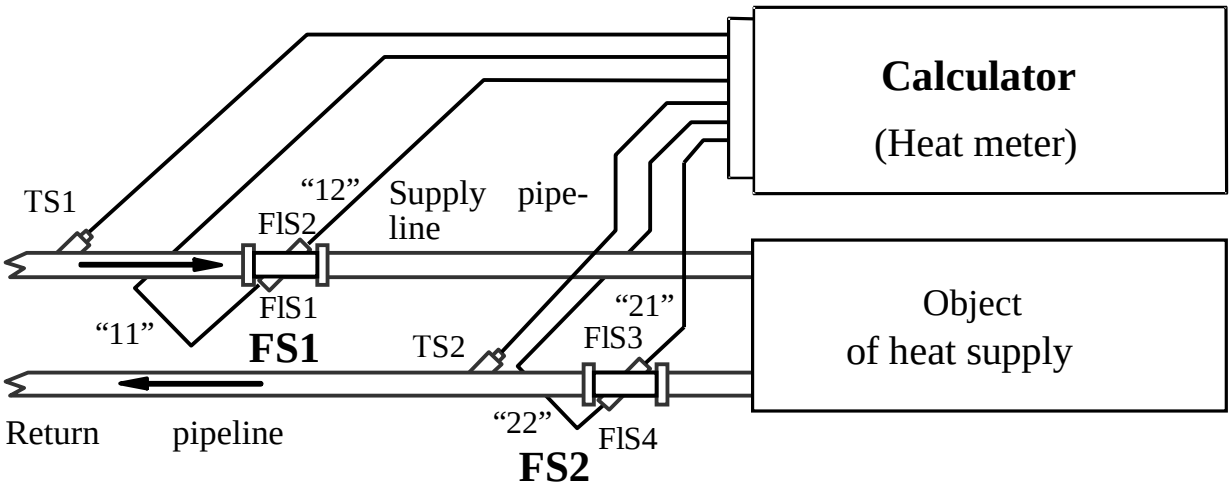
Configuration 3



Basic function is volume measurement

Two independent flow meters

Configuration 4



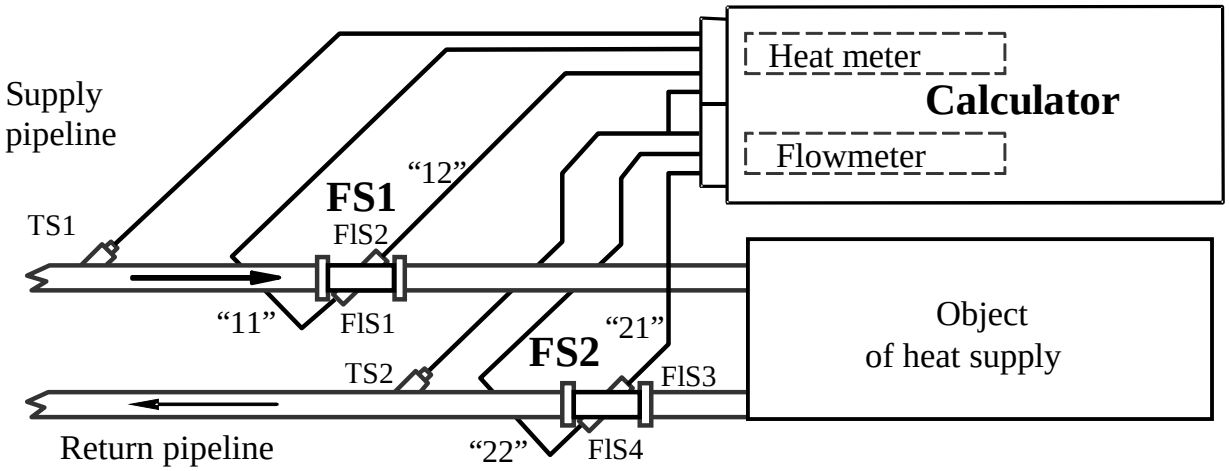
Basic function is heat energy measurement,
cold water temperature is set programmatically

Heat meter for open heat supply system without cold water supply pipeline

The notice. Numeration of flow sensors and marking of cables are indicated according to the table 9.3.

Appendix B

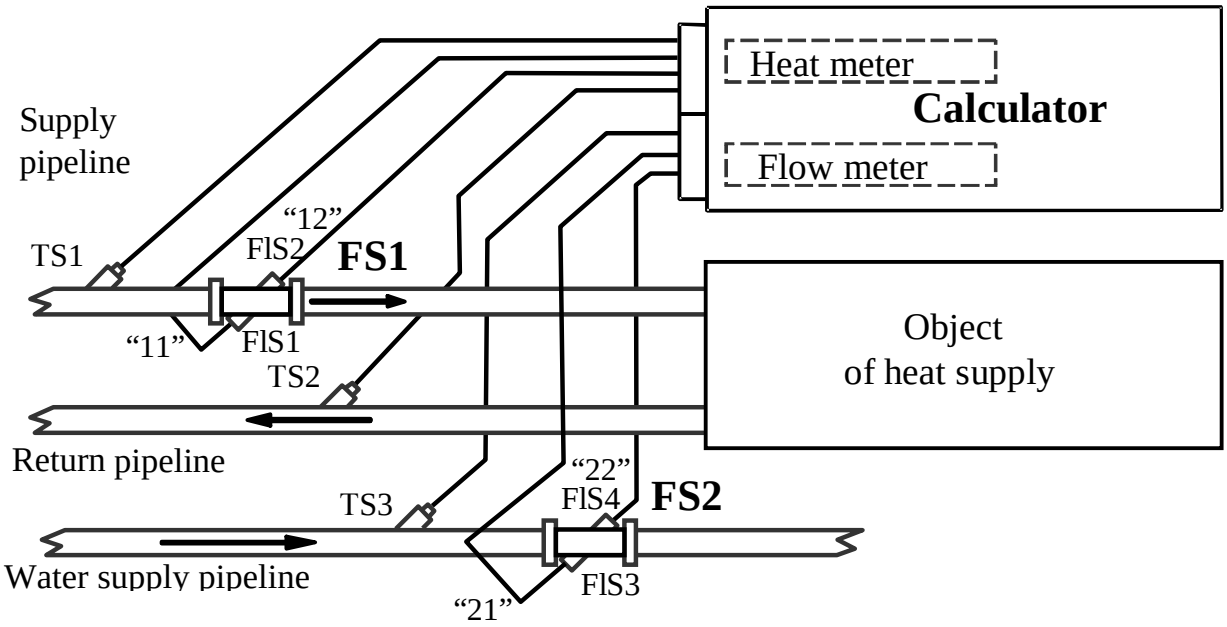
Configuration 5



Basic function is measurement of heat energy, additional function is measurement of heat-carrier volume in return pipeline.

Heat meter for closed heat supply system with check flow meter on the return pipeline

Configuration 6



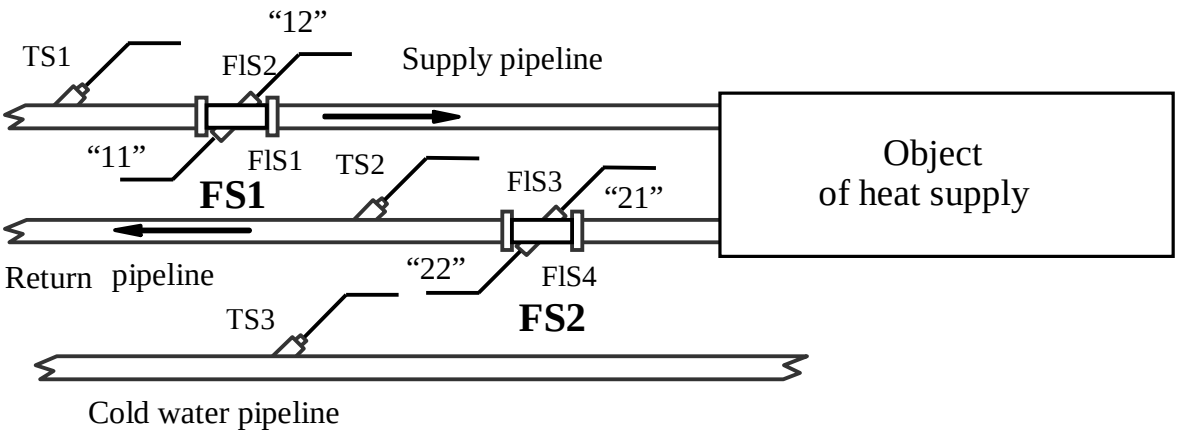
Basic function is measurement of heat energy, additional function is measurement of cold or hot water volume in water supply pipeline.

Heat meter for closed heat supply system and independent flow meter

The notice. Numeration of flow sensors and marking of cables are indicated according to the table 9.3.

Appendix B

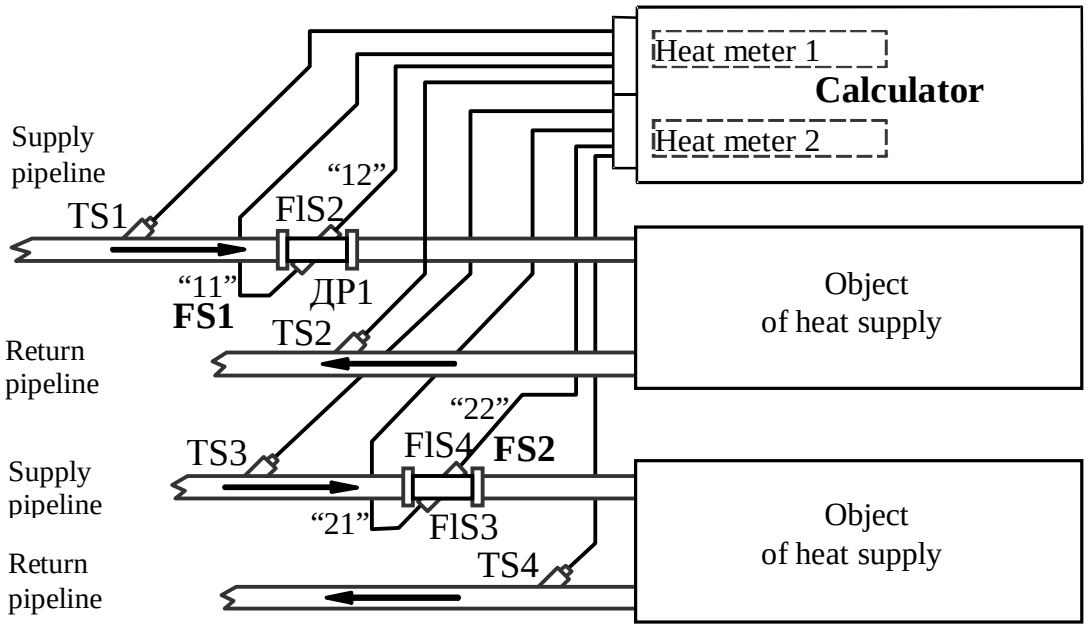
Configuration 7



Basic function is measurement of heat energy, temperature of cold water is measured

Heat meter for open heat supply system with cold water supply pipeline

Configuration 8



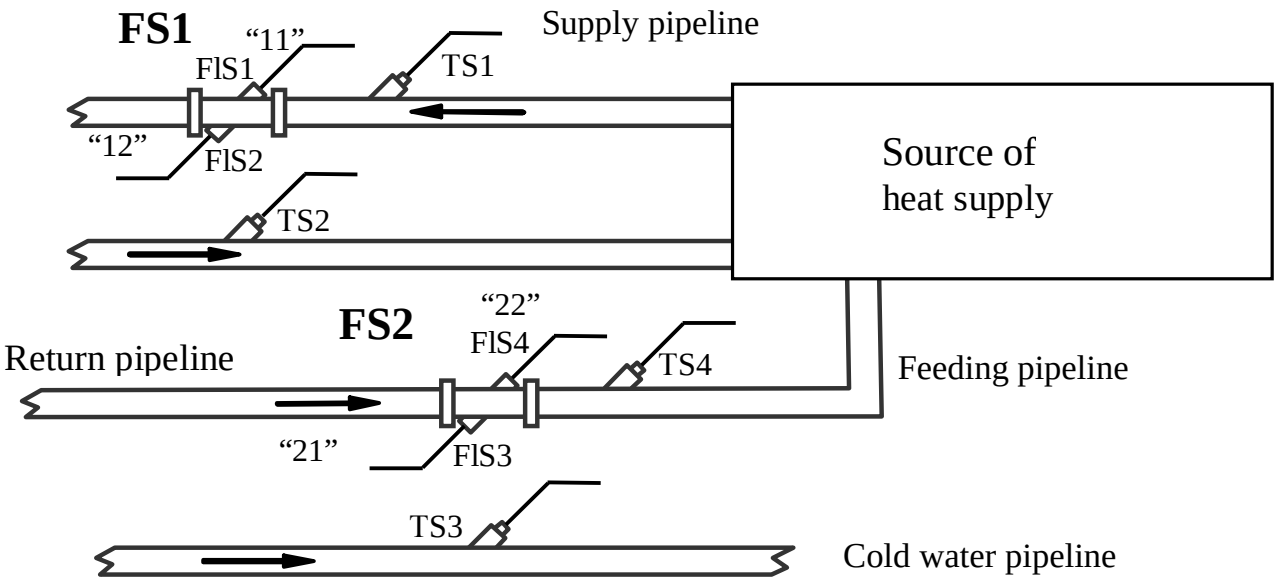
Basic function is measurement of heat energy on two objects of heat supply

Two independent heat meters for closed heat supply system

The notice. Numeration of flow sensors and marking of cables are indicated according to the table 9.3.

Appendix B

Configuration 9



Basic function is measurement of heat energy on object of heat supply

Heat meter with flow measurement in supply and feeding pipelines

Output configuration I (No built-in **MDM/REG** unit)

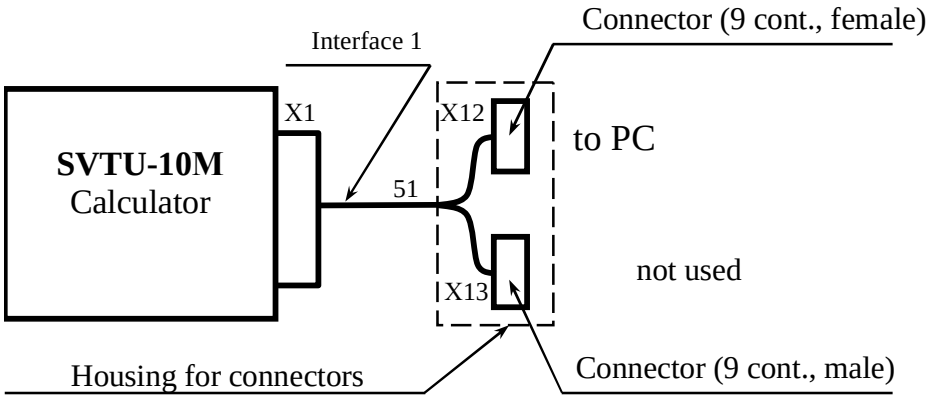


Figure C-1

Output configuration II (built-in MDM unit without REG unit)

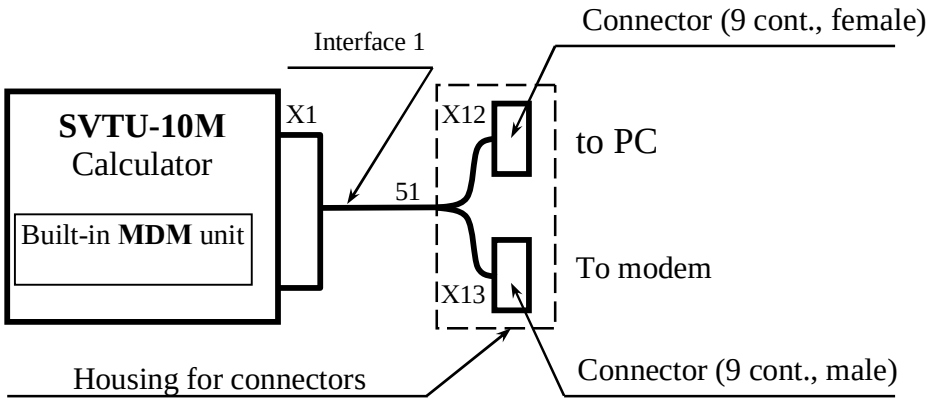


Figure C-2

The notice. Numeration of communication lines in figures is indicated according to the table 9.4.

Appendix C

Output configuration III (built-in MDM unit with RS485 but without REG unit)

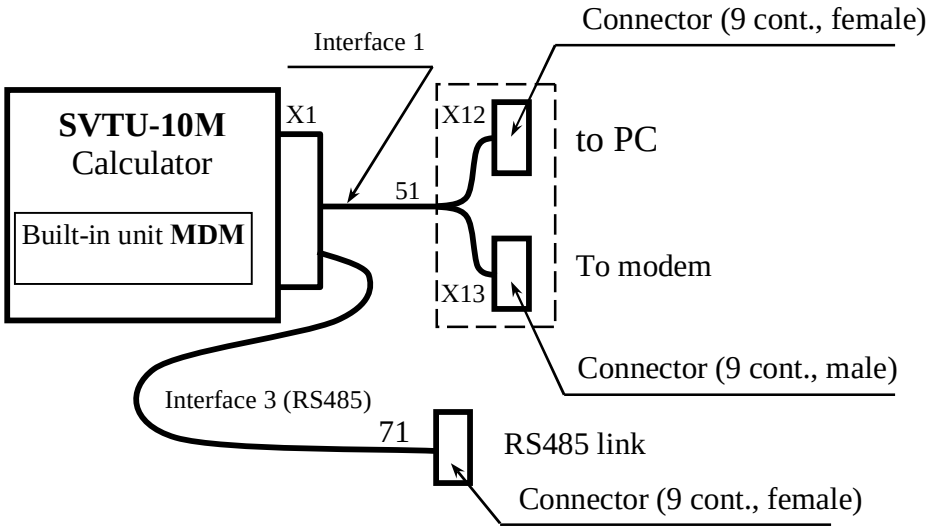


Figure C-3

Output configuration IV (built-in MDM unit with RS485 and with REG unit)

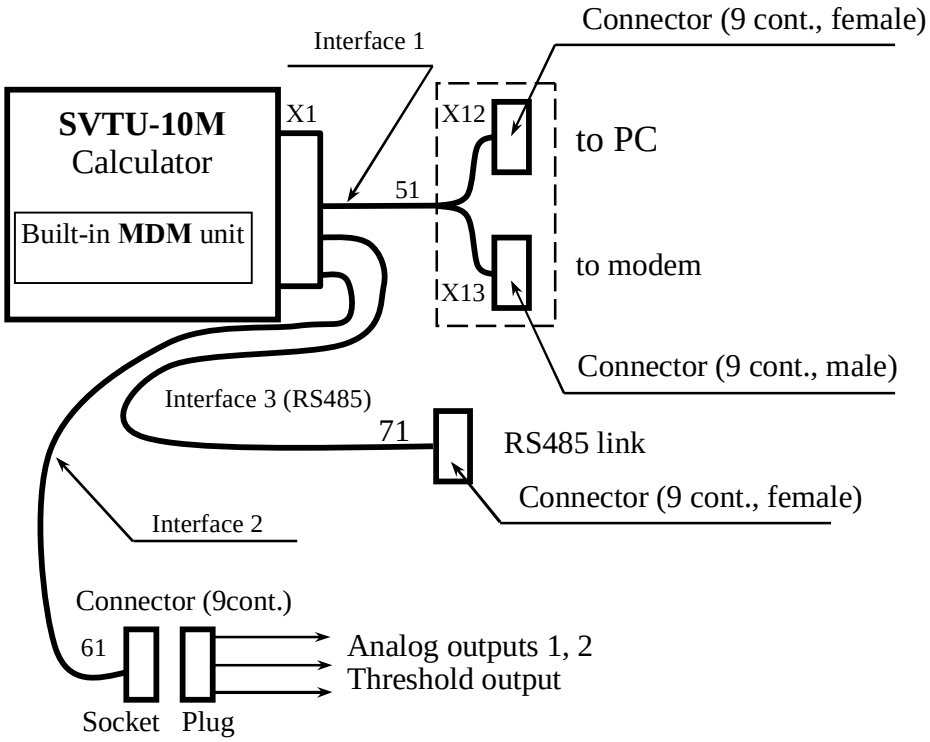
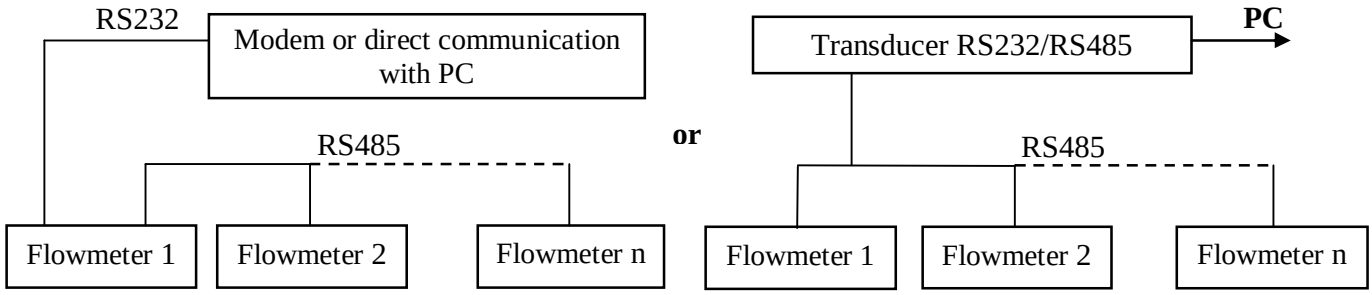


Figure C-4

The notice. Numeration of communication lines in figures is indicated according to the table 9.4.

Use of RS485 Interface

While using RS485 interface it is possible to connect simultaneously some meters (or other SEMPAL devices) and to have access to any of them. For this the only one device should be with an output to external lines.



The total length of communication line RS485 should not exceed 2 km. Thus devices should be connected by 'queue'. On the ends of a connecting cable the terminating resistances (120 Ohm) (crossbars between contacts 7 and 8 of sockets are unsoldered) should be installed. The scheme for connecting cable RS485 (it is mounted by the user) is given below. Installation should be accomplished by twisted pair.

Connectors of a connecting cable are attached to a connector 71 of device cable on each meter.

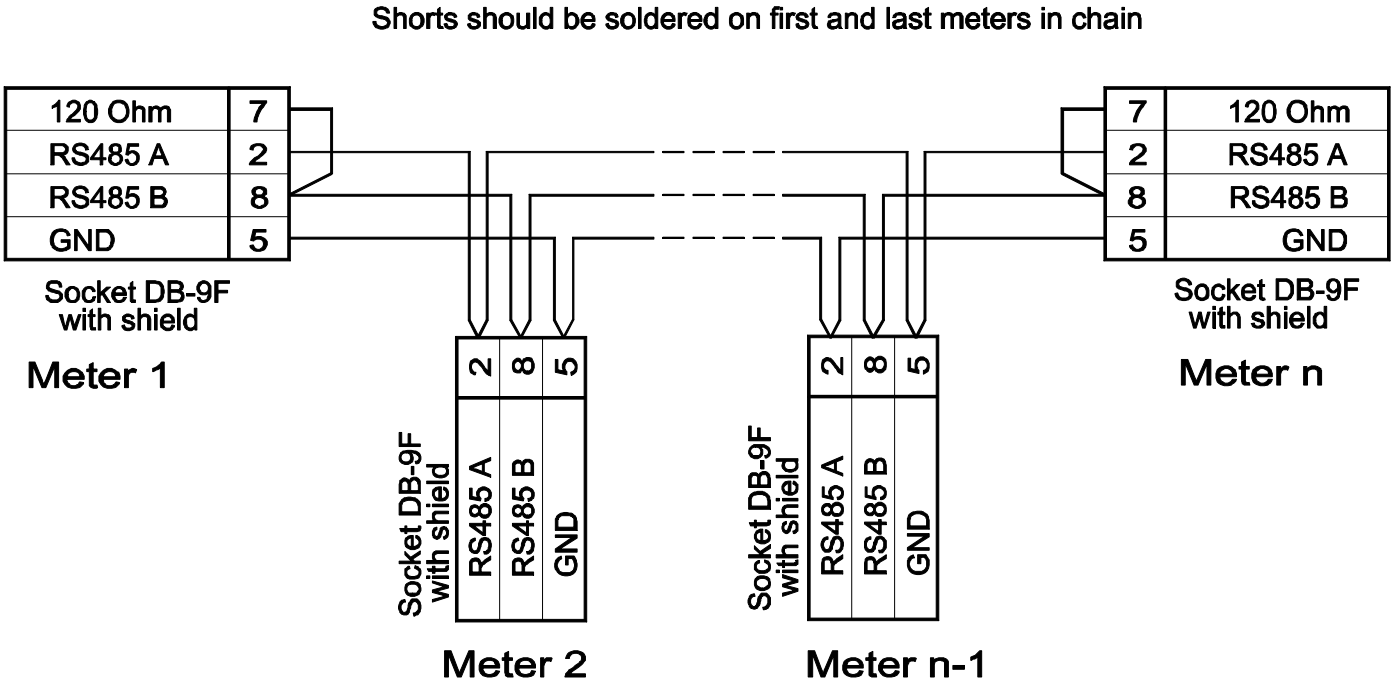
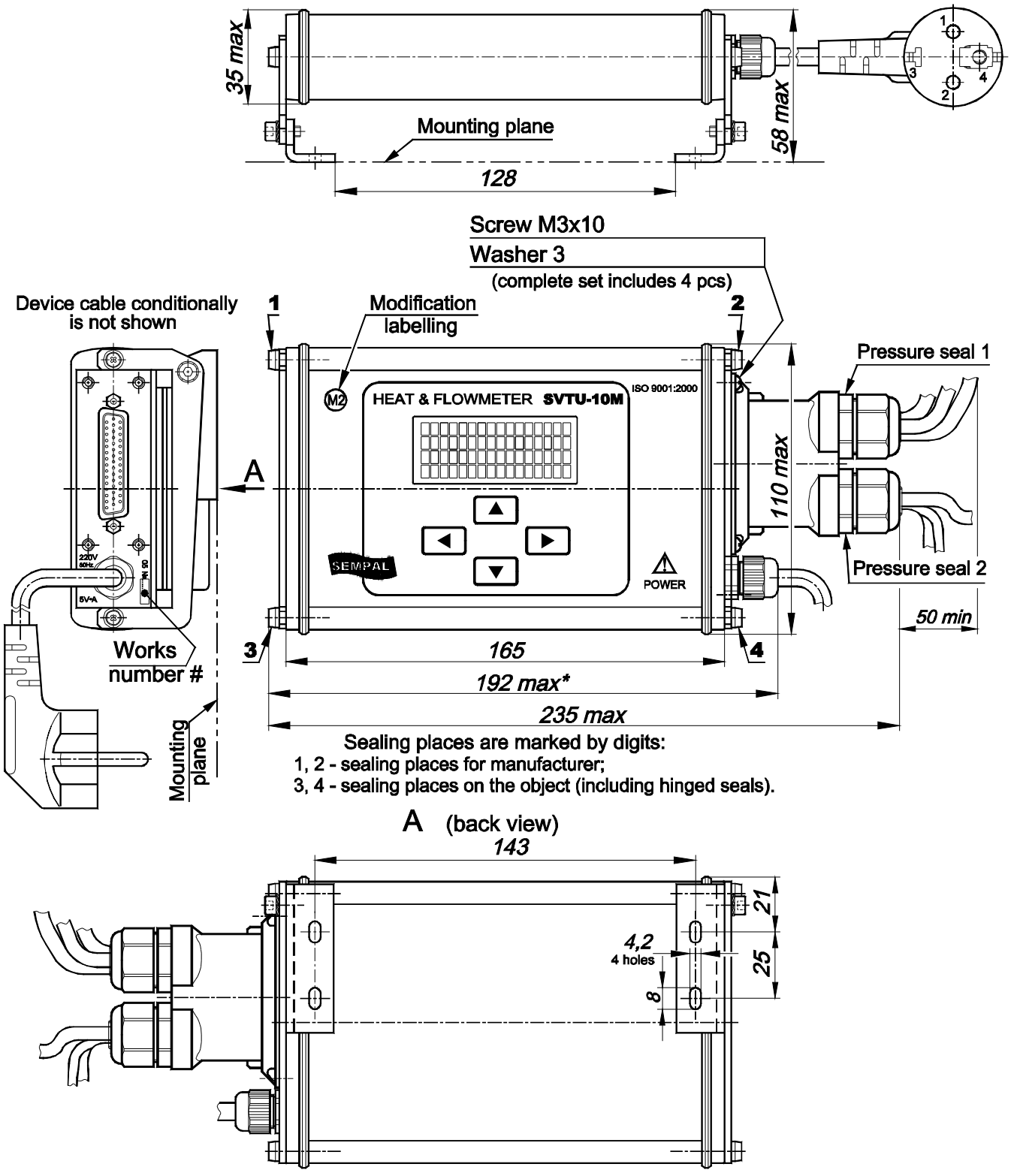


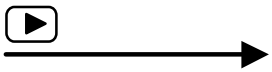
Figure C-5


35 max
Mounting plane
128
58 max
1
2
3
4
Screw M3x10
Washer 3
(complete set includes 4 pcs)
Device cable conditionally is not shown
Modification labelling
HEAT & FLOWMETER SVTU-10M
ISO 9001:2000
SEMPAL
POWER
Pressure seal 1
Pressure seal 2
110 max
50 min
A
Works number #
Mounting plane
165
192 max*
235 max
Sealing places are marked by digits:
1, 2 - sealing places for manufacturer;
3, 4 - sealing places on the object (including hinged seals).
A (back view)
143
4,2
4 holes
8
21
25

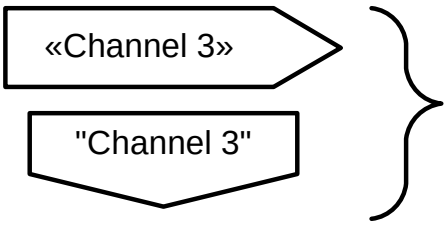
Reference designations

The buttons below have the following meanings:

▶ - «Right», ▲ - «Up», ▼ - «Down», ◀ - «Left».



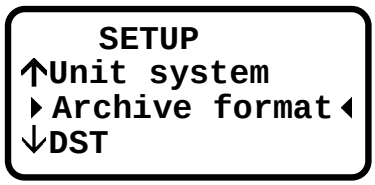
Result from pressing a corresponding button
(Note: in this case from pressing the ▶ button)



Continuation is followed on a next page with the corresponding title

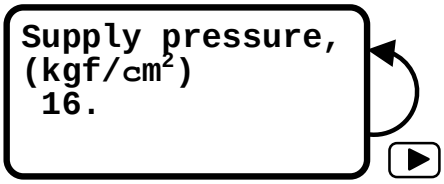
Menu items denoted as (★) are indicated only for corresponding meter configuration. For example, temperature of cold water is shown only for configurations 4 and 9.

Showing menu on display



Symbols "▸ ◂" point to a chosen item on the screen. Pressing the button "▸" will execute the chosen item. To return to the previous menu press "◂".

Symbols "↑" and "↓" show previous and next items on the menu.
Some items are password protected, which ask for a password after pressing the "▸" button.



Editing of some parameter

Editing can be performed by the following three steps:

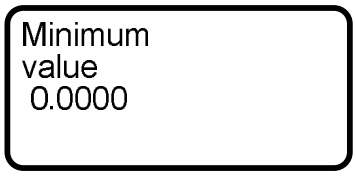
- displaying current value of parameter;
- editing the parameter. To start editing press "▸" button;
- displaying edited result.

After pressing the "" button appears "" symbol, which is a sign of editing process.

There are two editing modes:

- editing of digital value

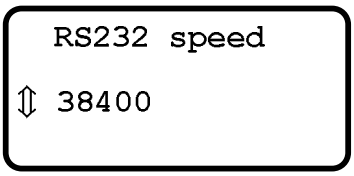
- choose item from the list



Editing of digital value.

Symbol "⇳" points to a current digit position. Edition of the digit is carried out by pushing "▼" and "▲" buttons. Selecting the next digit is carried out by "▶" button. To finish editing press the "◀" button, which follows by the disappearance of the symbol "⇳".

The last digit of a floating point number can differ by one from what is initially entered.



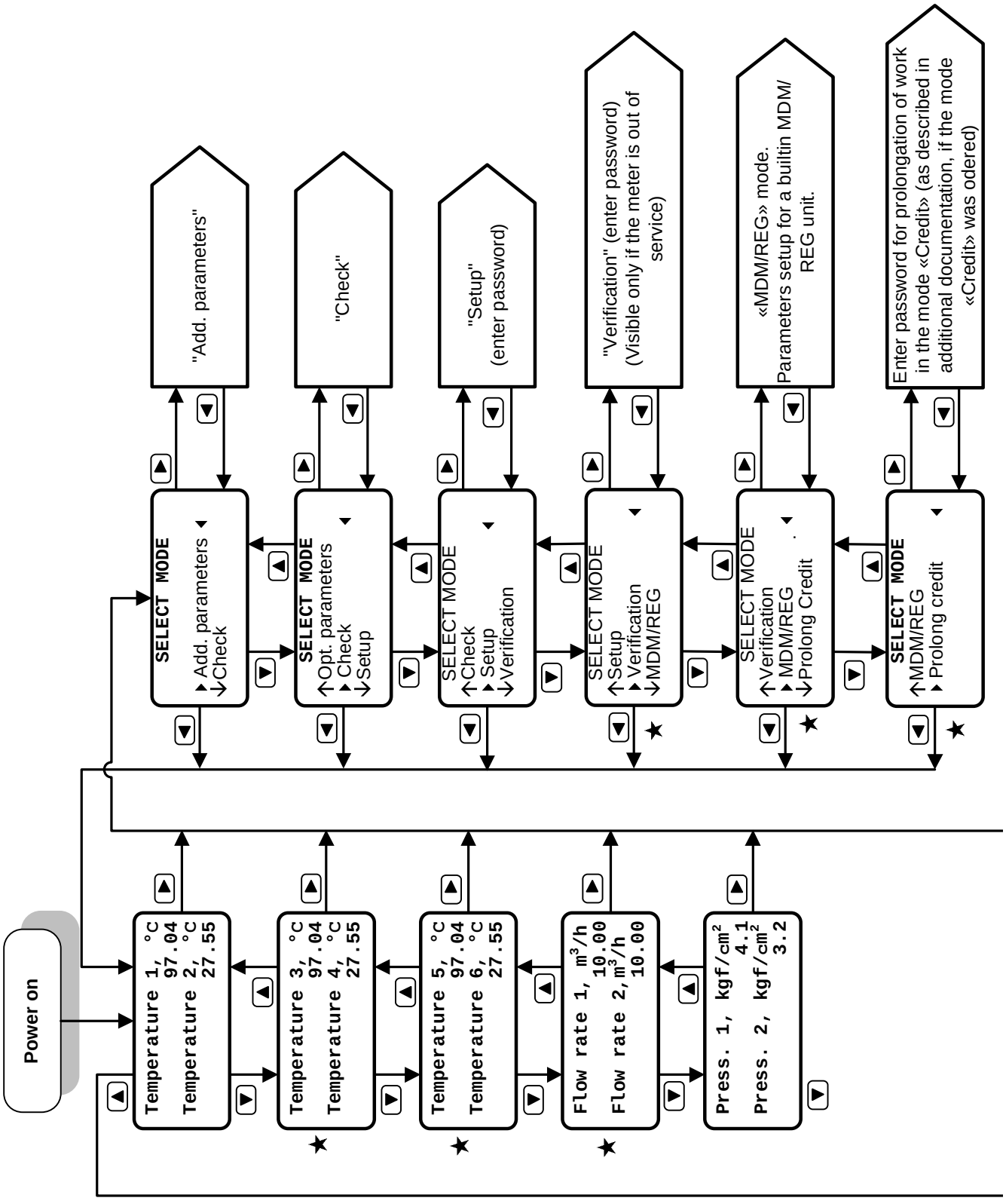
Choose item from the list

Symbol "⇳" to the left of the parameter value shows that value of the parameter should be chosen from the list.
Buttons "▼" and "▲" are used for scrolling through the item selection list.
To finish editing press the "◀" button.
To cancel editing press "▼" and "▲" simultaneously.

Remarks:

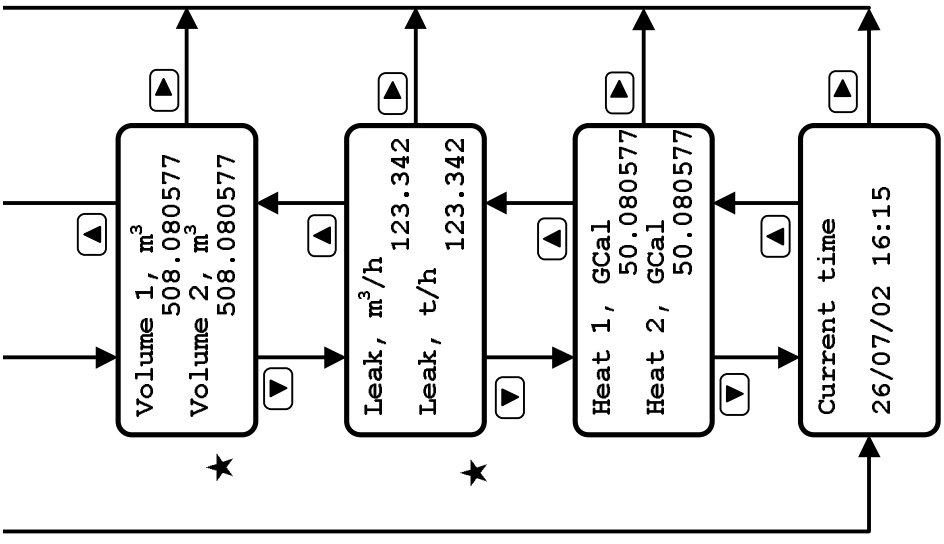
1. Holding any buttons for more than 0.5 sec will result in the autorepeat of that button with the rate of 3 symbols per second.
2. If entered an invalid parameter, the meter displays an error message. Pressing any button clears error message and returns to previous menu.

Indication of basic parameters mode



Appendix E

‘Indication of basic parameters’ mode



★ **Note.**
Menu items denoted as (★) are indicated only for corresponding meter configuration

‘Indication of additional parameters’ mode

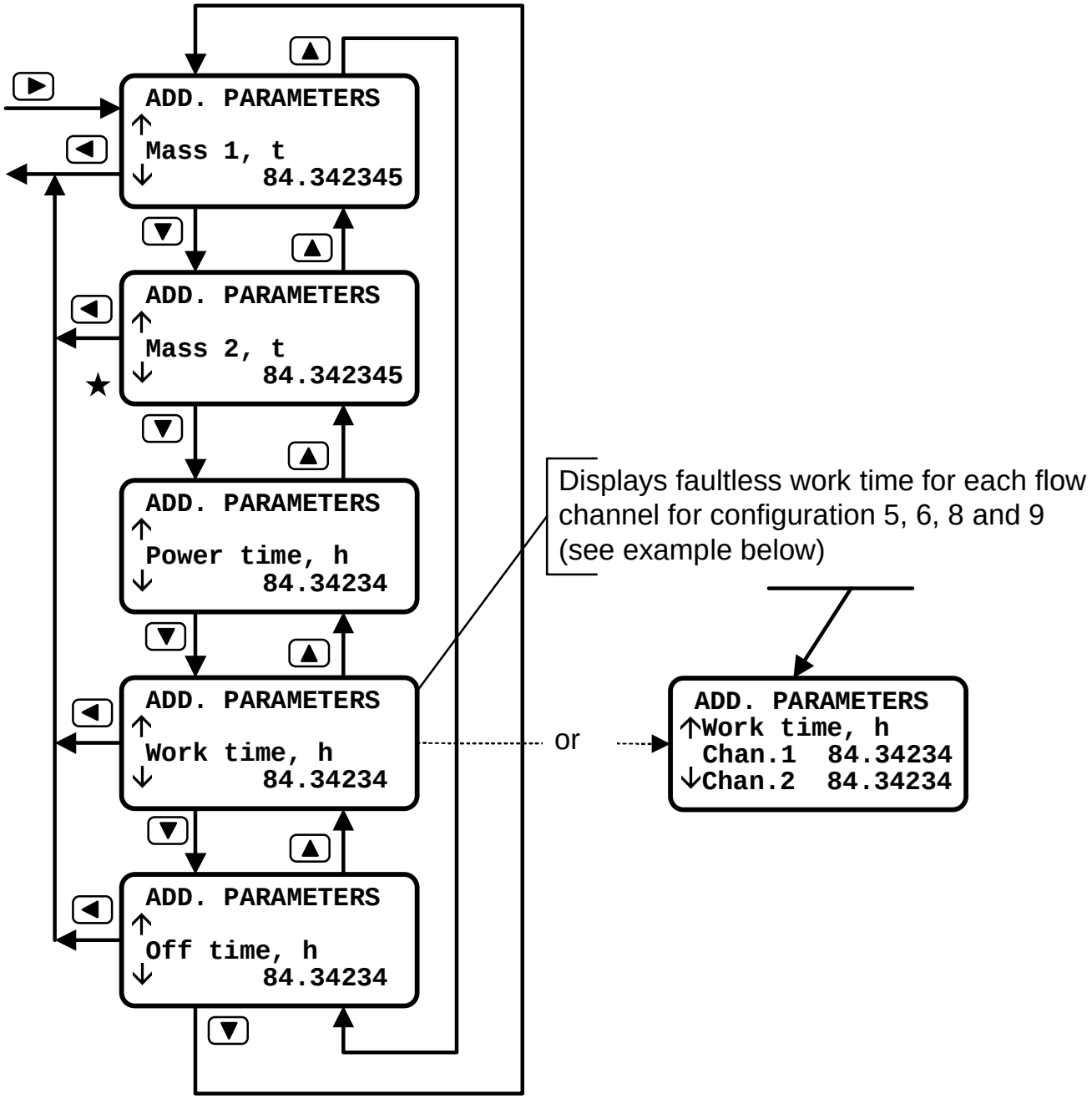
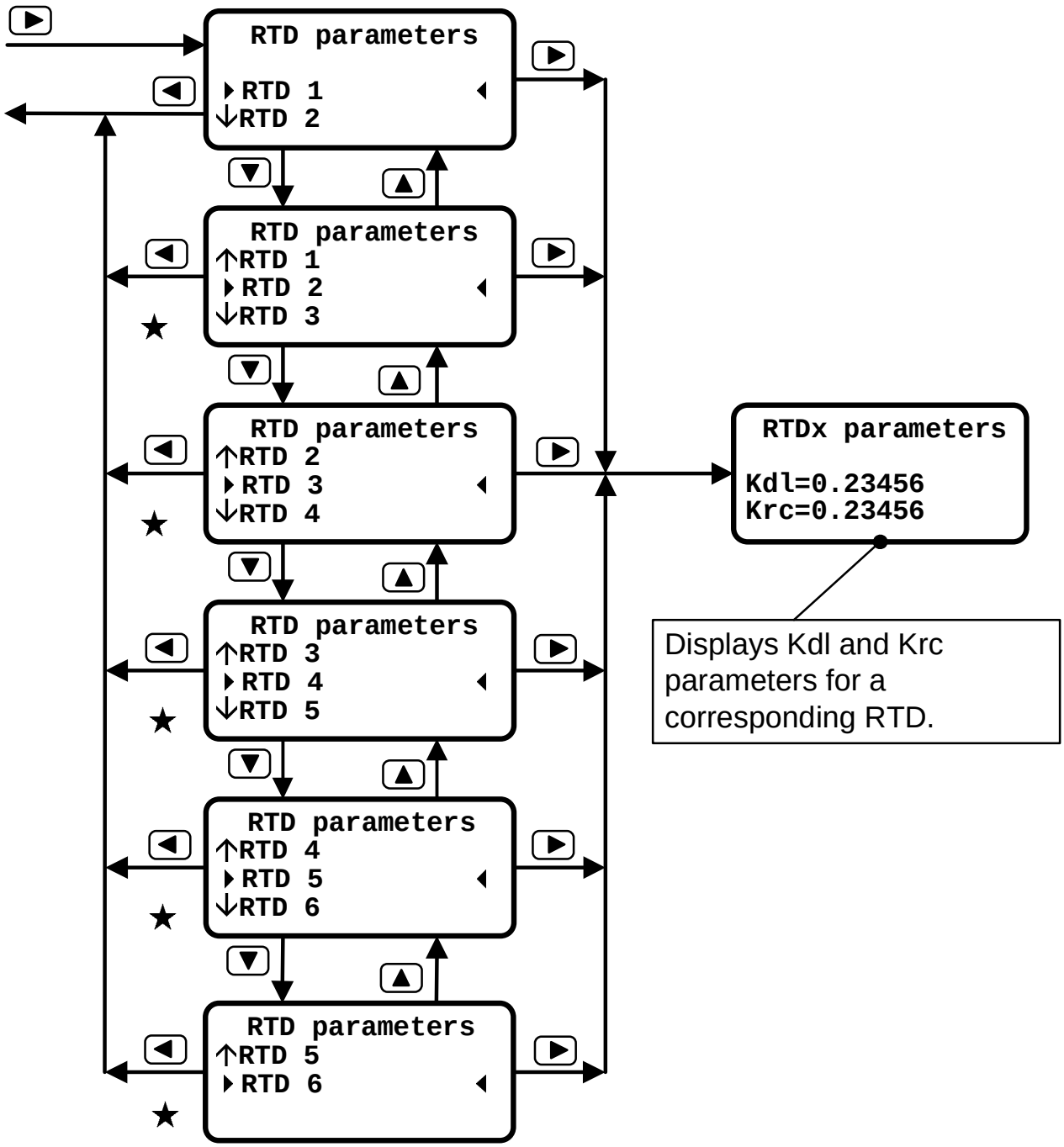


Figure E-2

‘Check’ mode

(general algorithm of the ’Check mode’ is represented on the next page)

‘Check/parameters of RTD’ mode

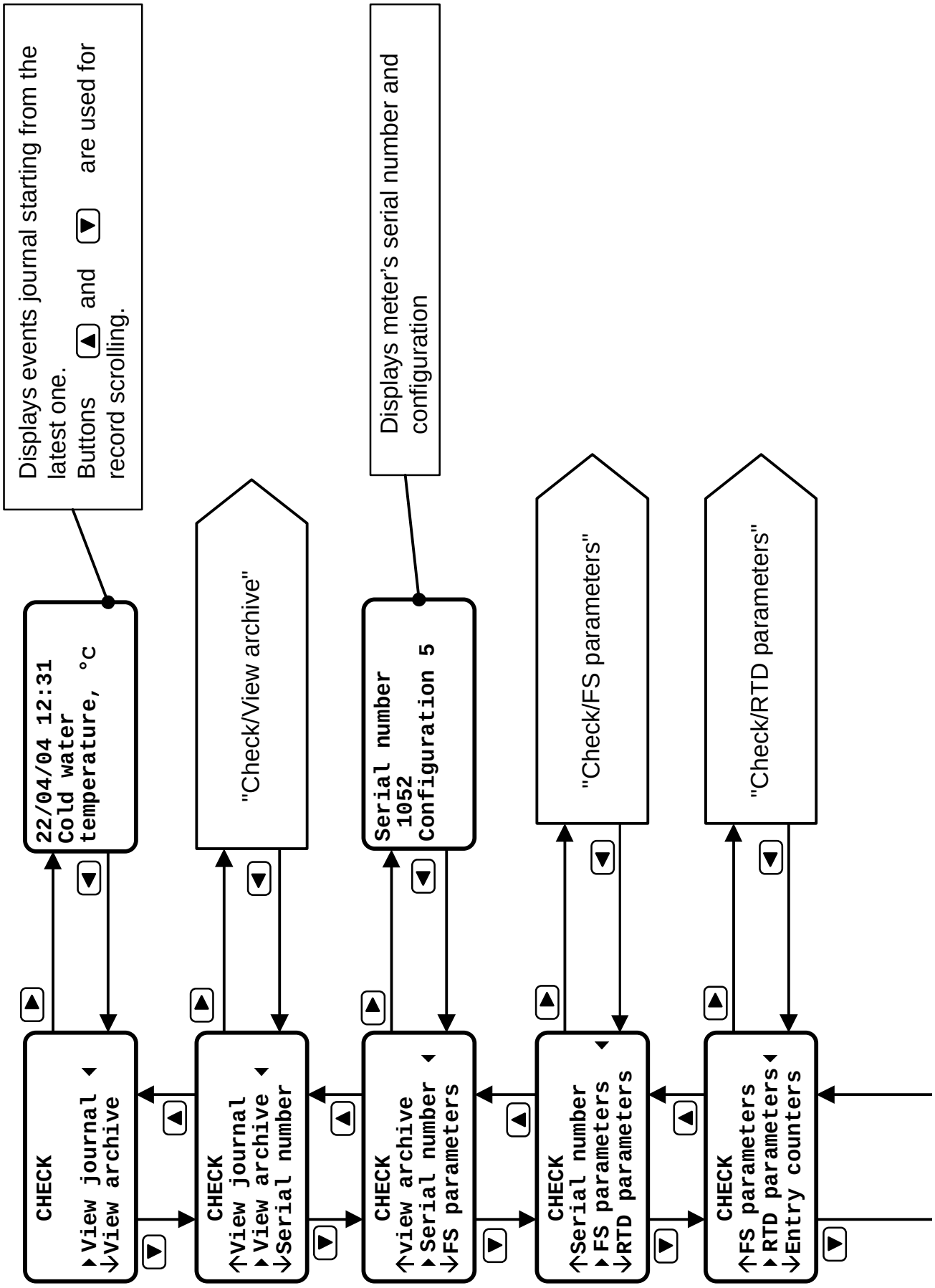


★ **Note.**

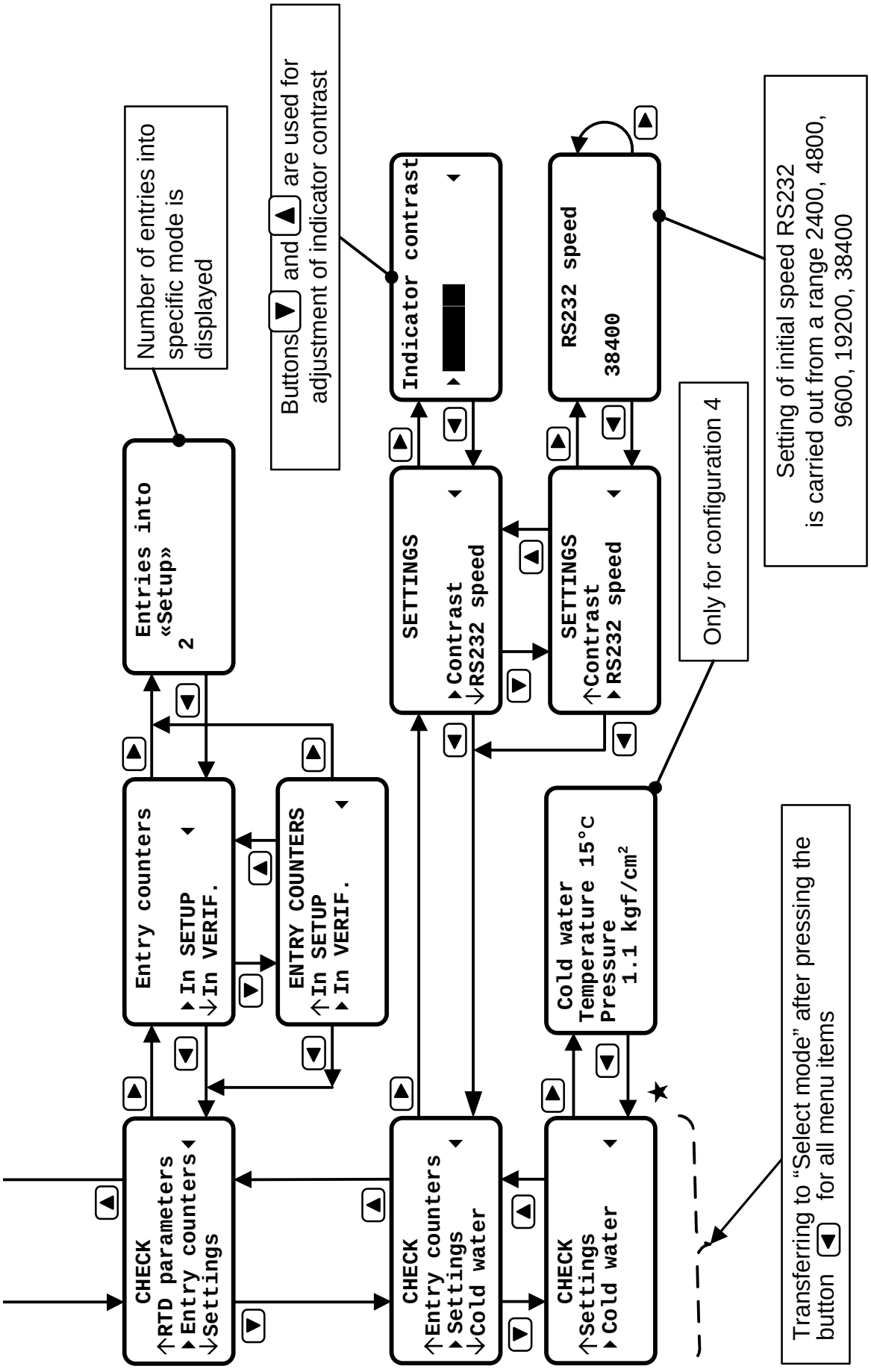
Menu items denoted as (★) are indicated only for corresponding meter configuration

Figure E-3

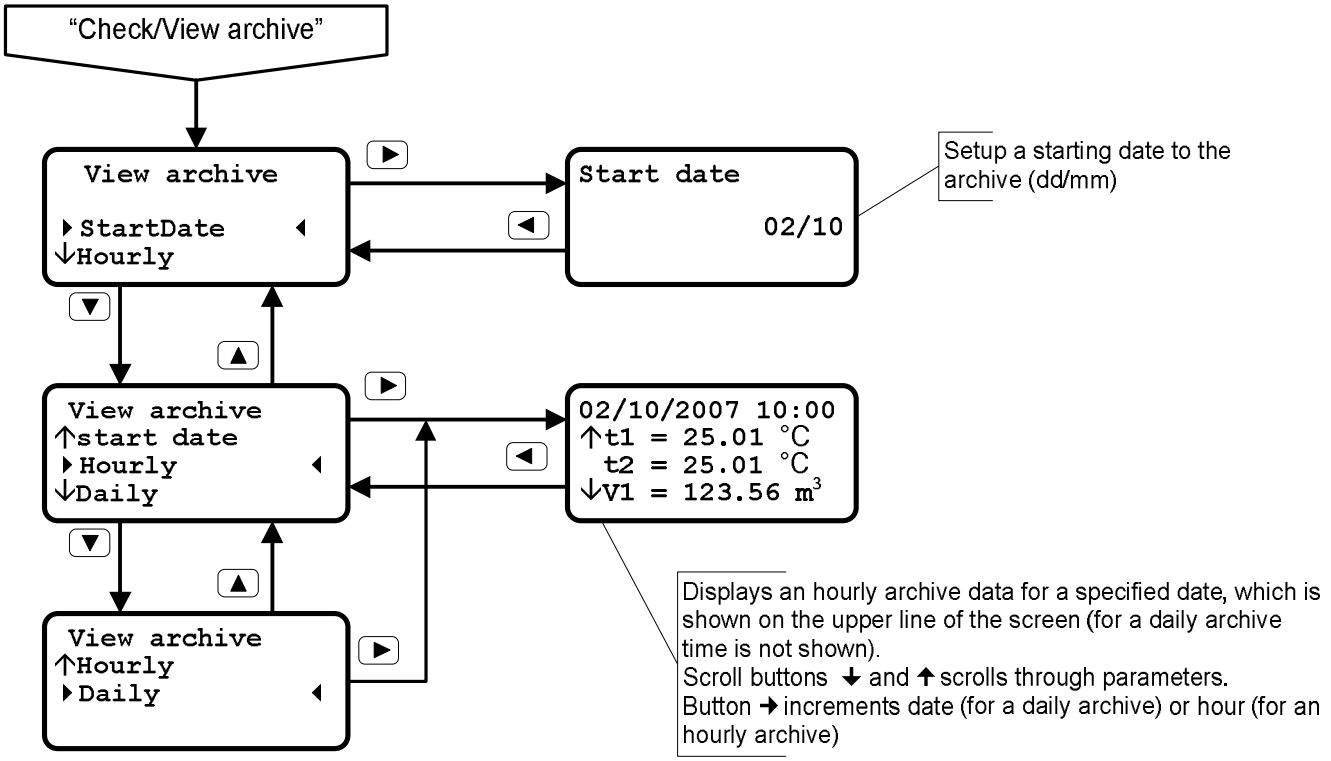
‘Check’ mode


Displays events journal starting from the latest one.
Buttons ▲ and ▼ are used for record scrolling.
22/04/04 12:31
Cold water temperature, °c
Displays meter’s serial number and configuration
Serial number
1052
Configuration 5
"Check/View archive"
"Check/FS parameters"
"Check/RTD parameters"
CHECK
▸View journal ◂
↓View archive
CHECK
↑View journal
▸View archive ◂
↓Serial number
CHECK
↑view archive
▸Serial number ◂
↓FS parameters
CHECK
↑Serial number
▸FS parameters ◂
↓RTD parameters
CHECK
↑FS parameters
▸RTD parameters ◂
↓Entry counters

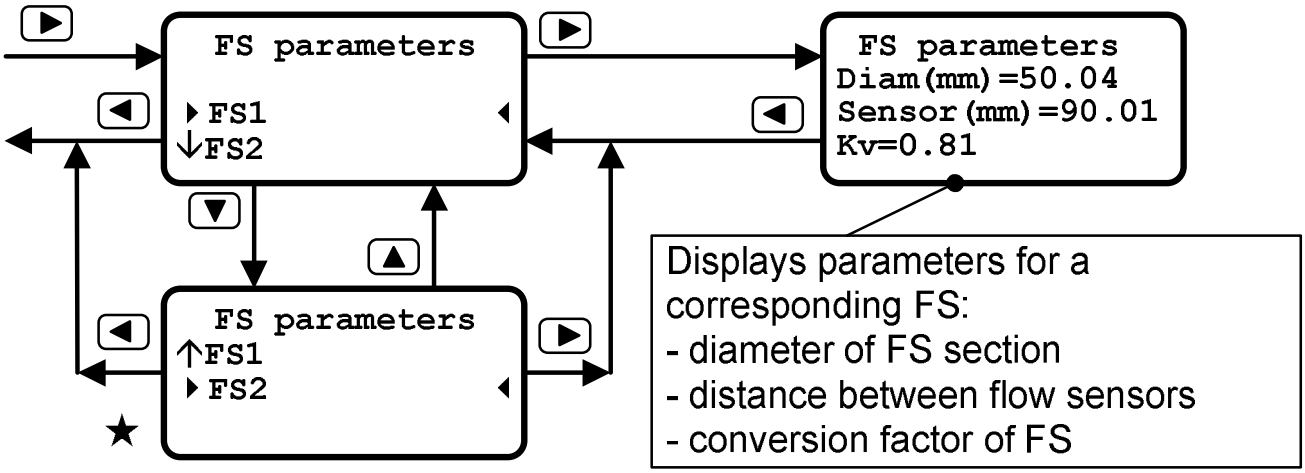
‘Check’ mode


Number of entries into specific mode is displayed
Buttons ▼ and ▲ are used for adjustment of indicator contrast
Setting of initial speed RS232 is carried out from a range 2400, 4800, 9600, 19200, 38400
Only for configuration 4
Transferring to “Select mode” after pressing the button ◄ for all menu items
CHECK
↑RTD parameters
▸Entry counters
↓Settings
Entry counters
▸In SETUP
↓In VERIF.
Entries into «Setup»
2
ENTRY COUNTERS
↑In SETUP
▸In VERIF.
CHECK
↑Entry counters
▸Settings
↓Cold water
SETTINGS
▸Contrast
↓RS232 speed
Indicator contrast
SETTINGS
↑Contrast
▸RS232 speed
RS232 speed
38400
CHECK
↑Settings
▸Cold water
Cold water
Temperature 15°C
Pressure
1.1 kgf/cm²

‘Check/View archive’ mode

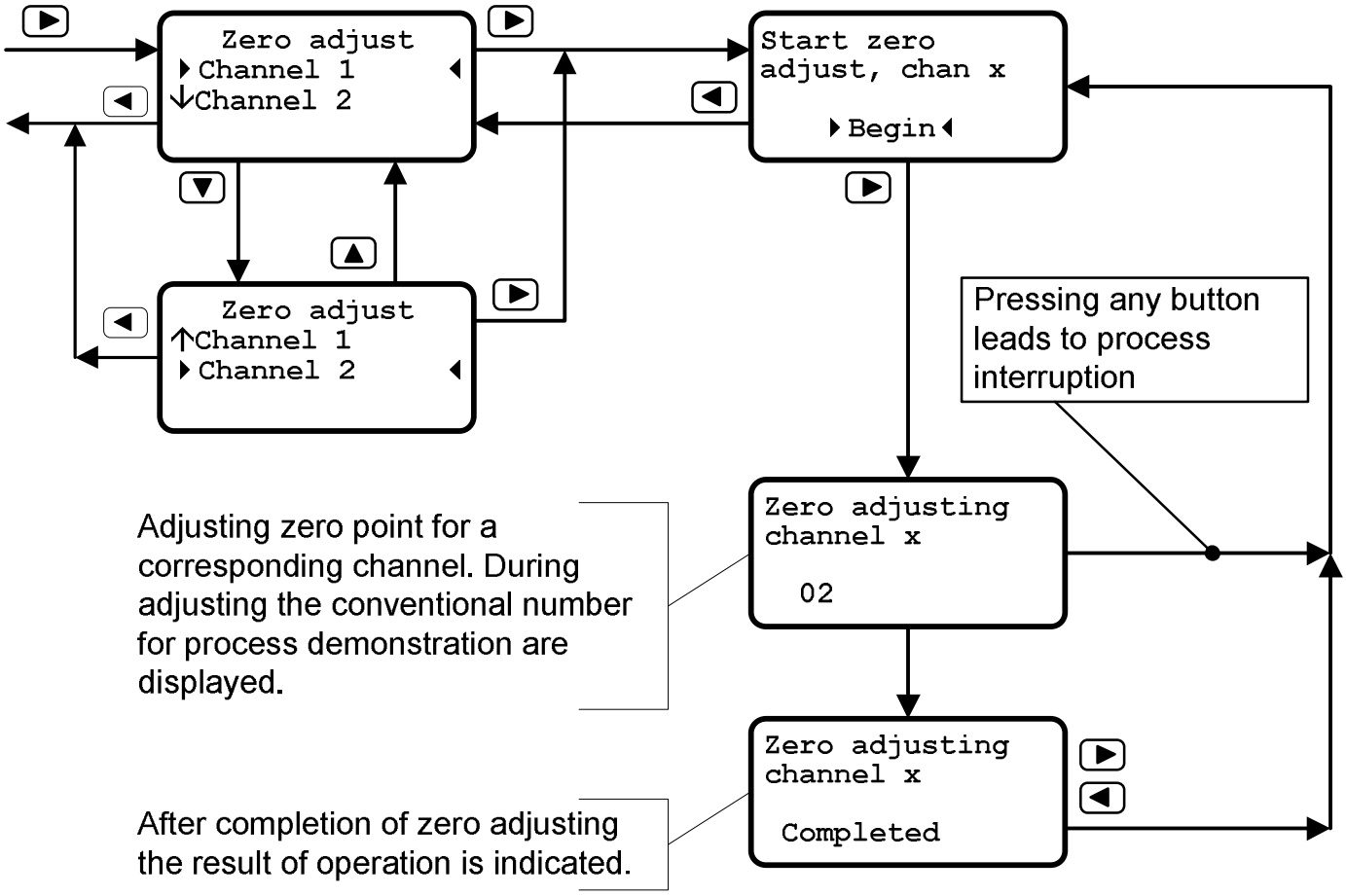

“Check/View archive”
View archive
StartDate
Hourly
Start date
02/10
Setup a starting date to the archive (dd/mm)
View archive
start date
Hourly
Daily
02/10/2007 10:00
t1 = 25.01 °C
t2 = 25.01 °C
V1 = 123.56 m3
View archive
Hourly
Daily
Displays an hourly archive data for a specified date, which is shown on the upper line of the screen (for a daily archive time is not shown).
Scroll buttons ↓ and ↑ scrolls through parameters.
Button → increments date (for a daily archive) or hour (for an hourly archive)

‘Check/View FS parameters’ mode

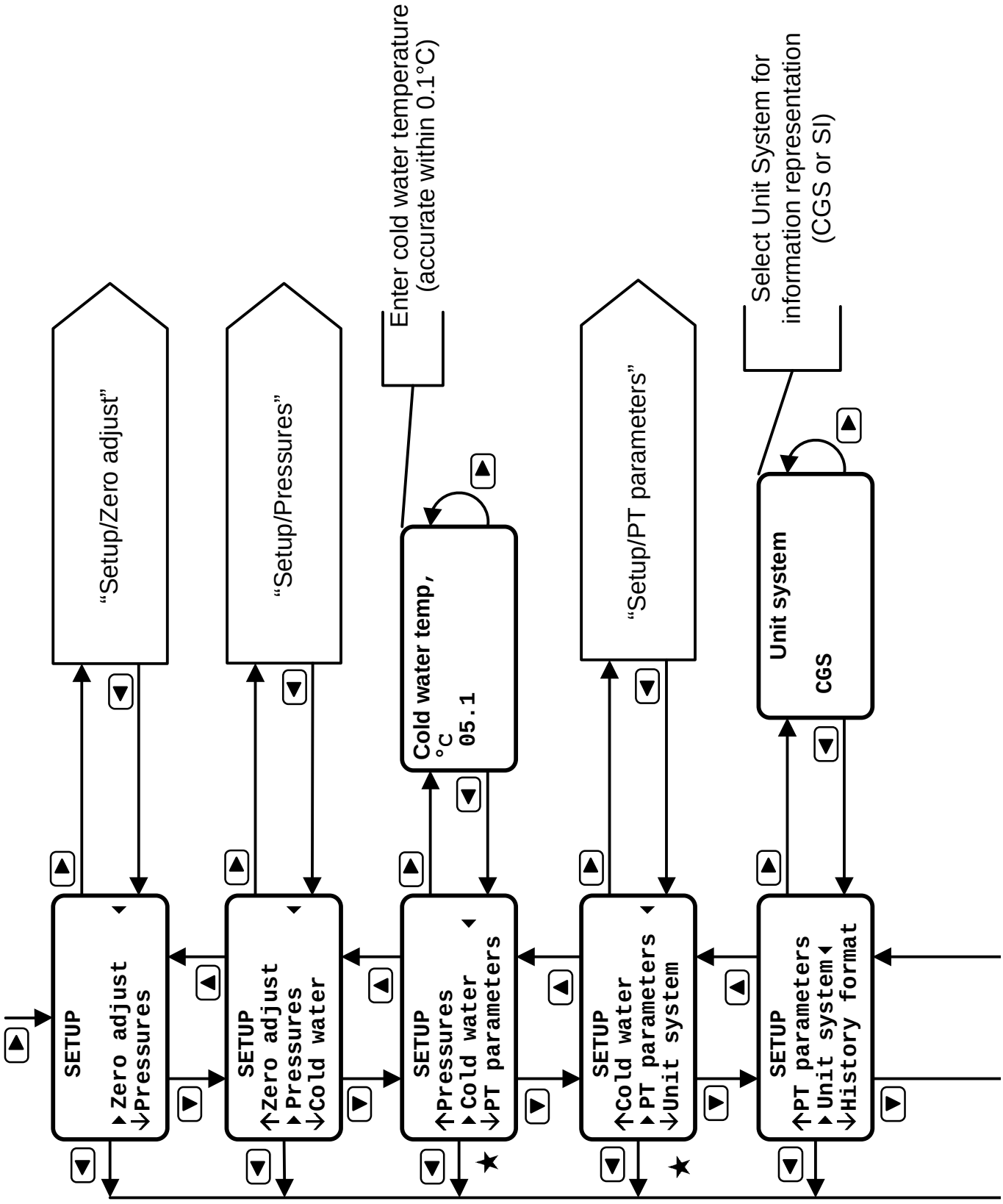


Appendix E

‘Setup/Set zero’ mode

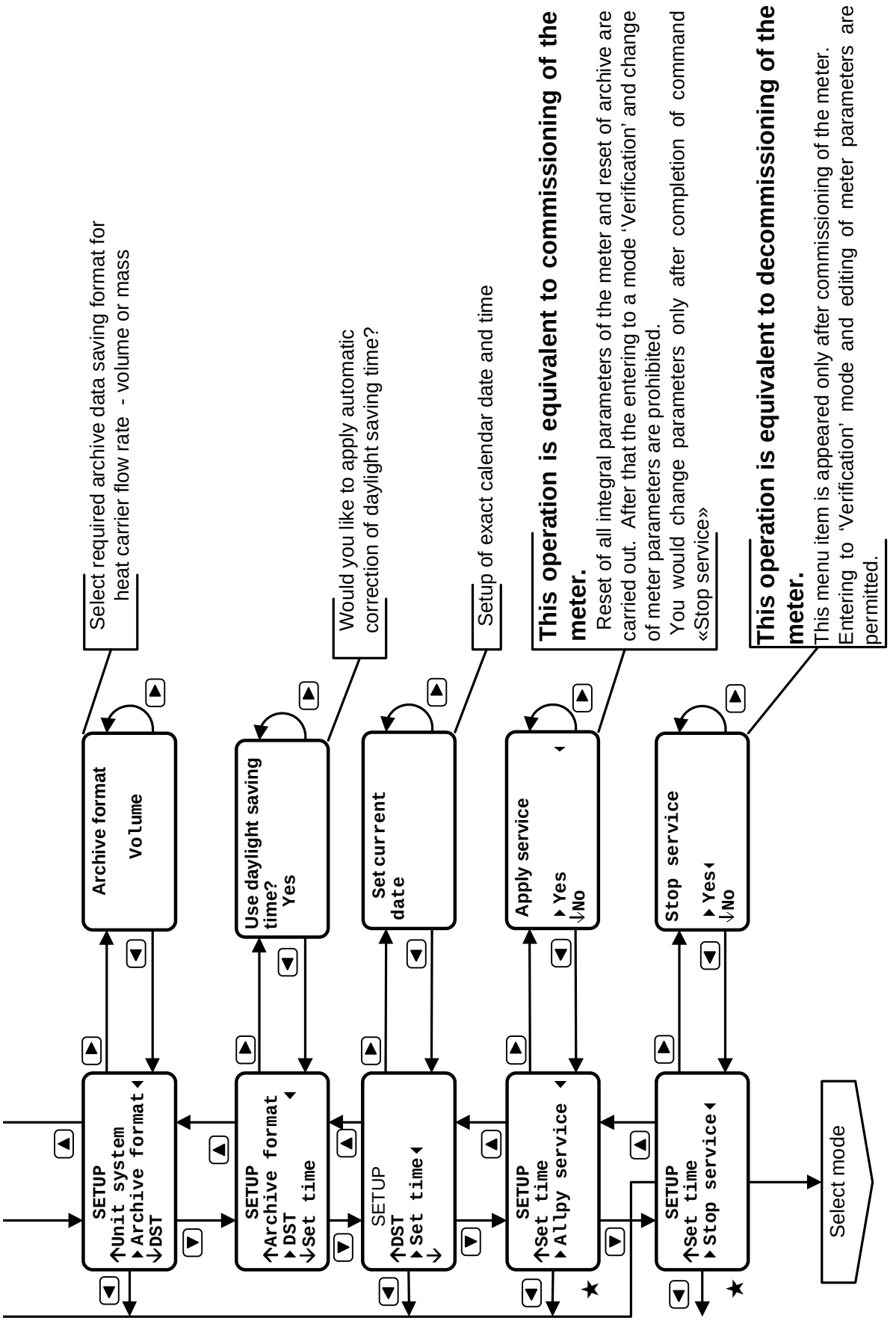

Zero adjust
Channel 1
Channel 2
Start zero adjust, chan x
Begin
Zero adjust
Channel 1
Channel 2
Pressing any button leads to process interruption
Zero adjusting channel x
02
Adjusting zero point for a corresponding channel. During adjusting the conventional number for process demonstration are displayed.
Zero adjusting channel x
Completed
After completion of zero adjusting the result of operation is indicated.

‘Setup’ mode

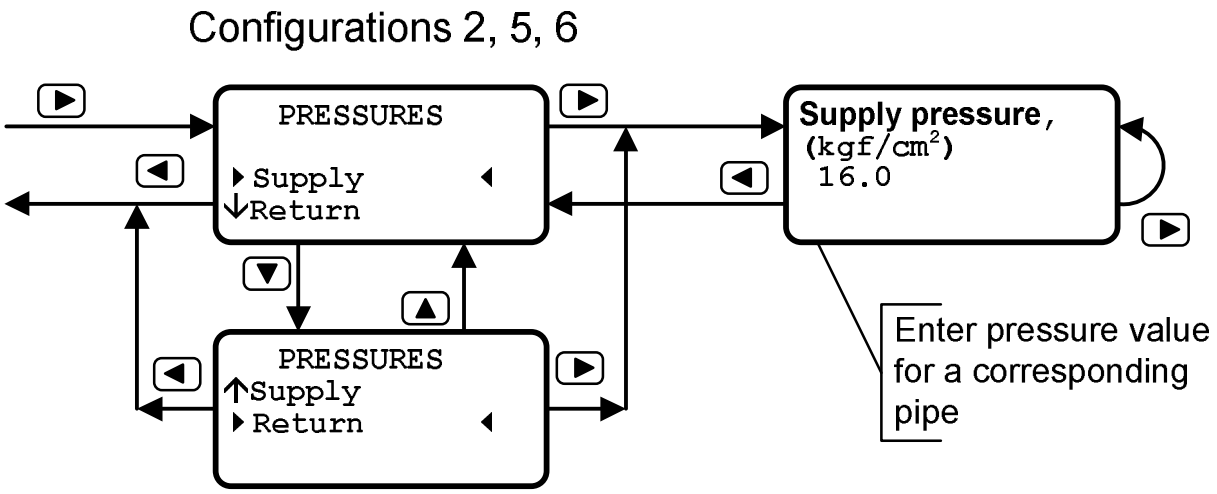

SETUP
▲Zero adjust
↓Pressures
SETUP
↑Zero adjust
▲Pressures
↓Cold water
SETUP
↑Pressures
▲Cold water
↓PT parameters
SETUP
↑Cold water
▲PT parameters
↓Unit system
SETUP
↑PT parameters
▲Unit system
↓History format
“Setup/Zero adjust”
“Setup/Pressures”
Enter cold water temperature
(accurate within 0.1°C)
Cold water temp,
°C
05.1
“Setup/PT parameters”
Select Unit System for
information representation
(CGS or SI)
Unit system
CGS

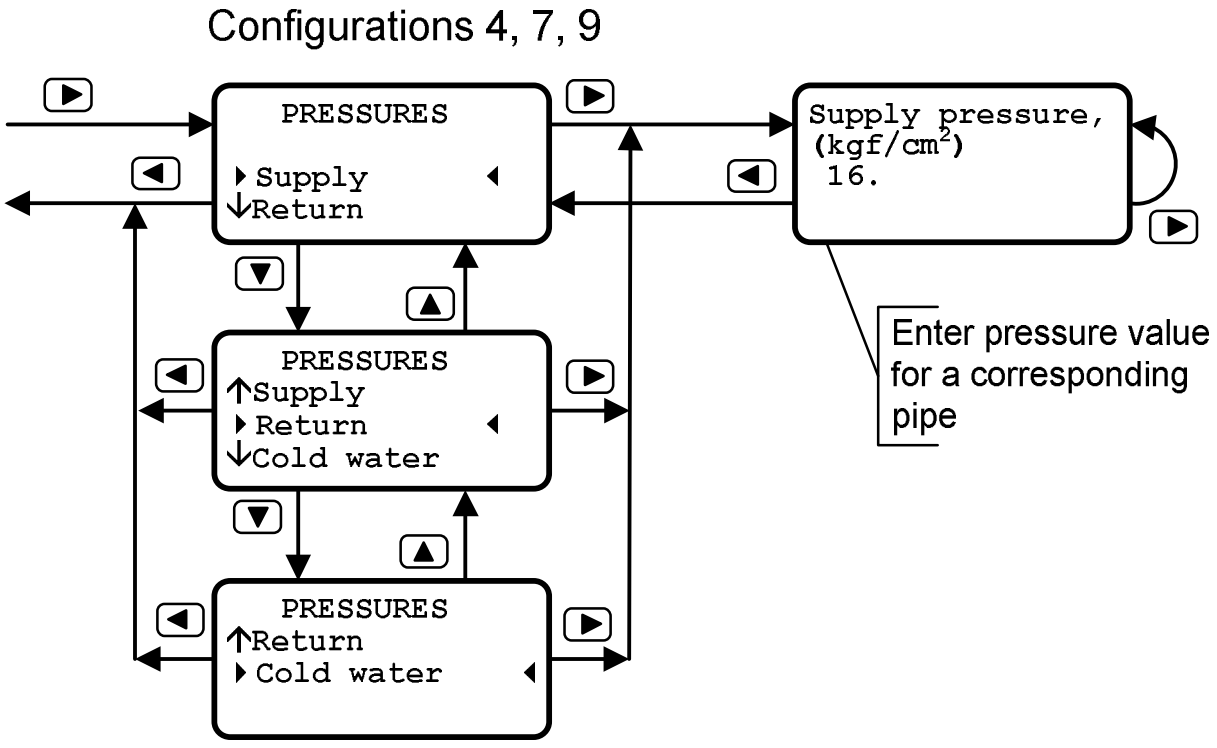
Appendix E

‘Setup’ mode


SETUP
↑Unit system
▸Archive format◂
↓DST
Archive format
Volume
Select required archive data saving format for heat carrier flow rate - volume or mass
SETUP
↑Archive format ▾
▸DST
↓Set time
Use daylight saving time?
Yes
Would you like to apply automatic correction of daylight saving time?
SETUP
↑DST
▸Set time◂
↓
Set current date
Setup of exact calendar date and time
SETUP
↑Set time
▸Allpy service ◂
Apply service
▸Yes
↓No
This operation is equivalent to commissioning of the meter.
Reset of all integral parameters of the meter and reset of archive are carried out. After that the entering to a mode ‘Verification’ and change of meter parameters are prohibited.
You would change parameters only after completion of command «Stop service»
SETUP
↑Set time
▸Stop service◂
Stop service
▸Yes◂
↓No
This operation is equivalent to decommissioning of the meter.
This menu item is appeared only after commissioning of the meter.
Entering to ‘Verification’ mode and editing of meter parameters are permitted.
Select mode

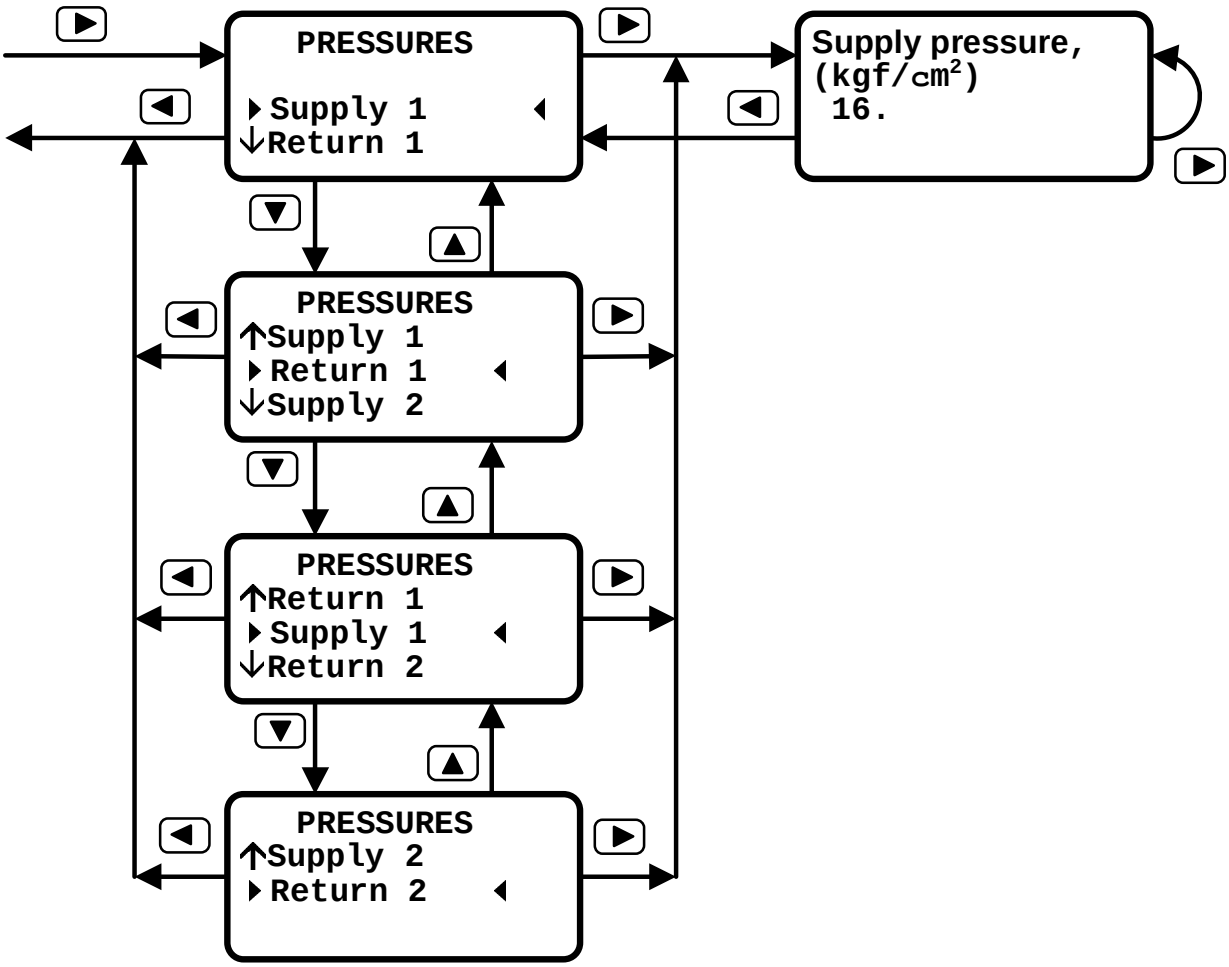
‘Setup/Pressure’ mode



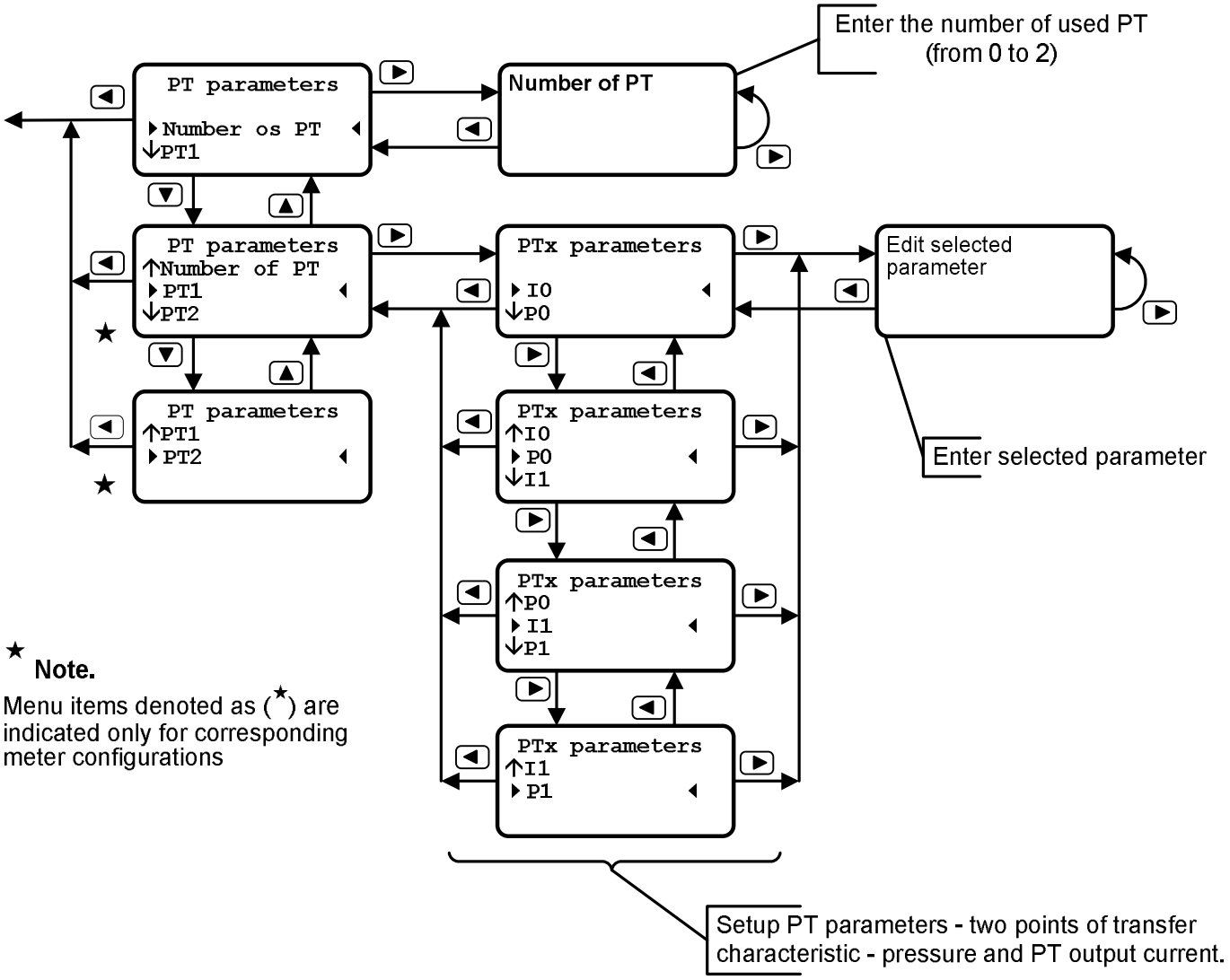


‘Setup/Pressure’ mode

Configuration 8

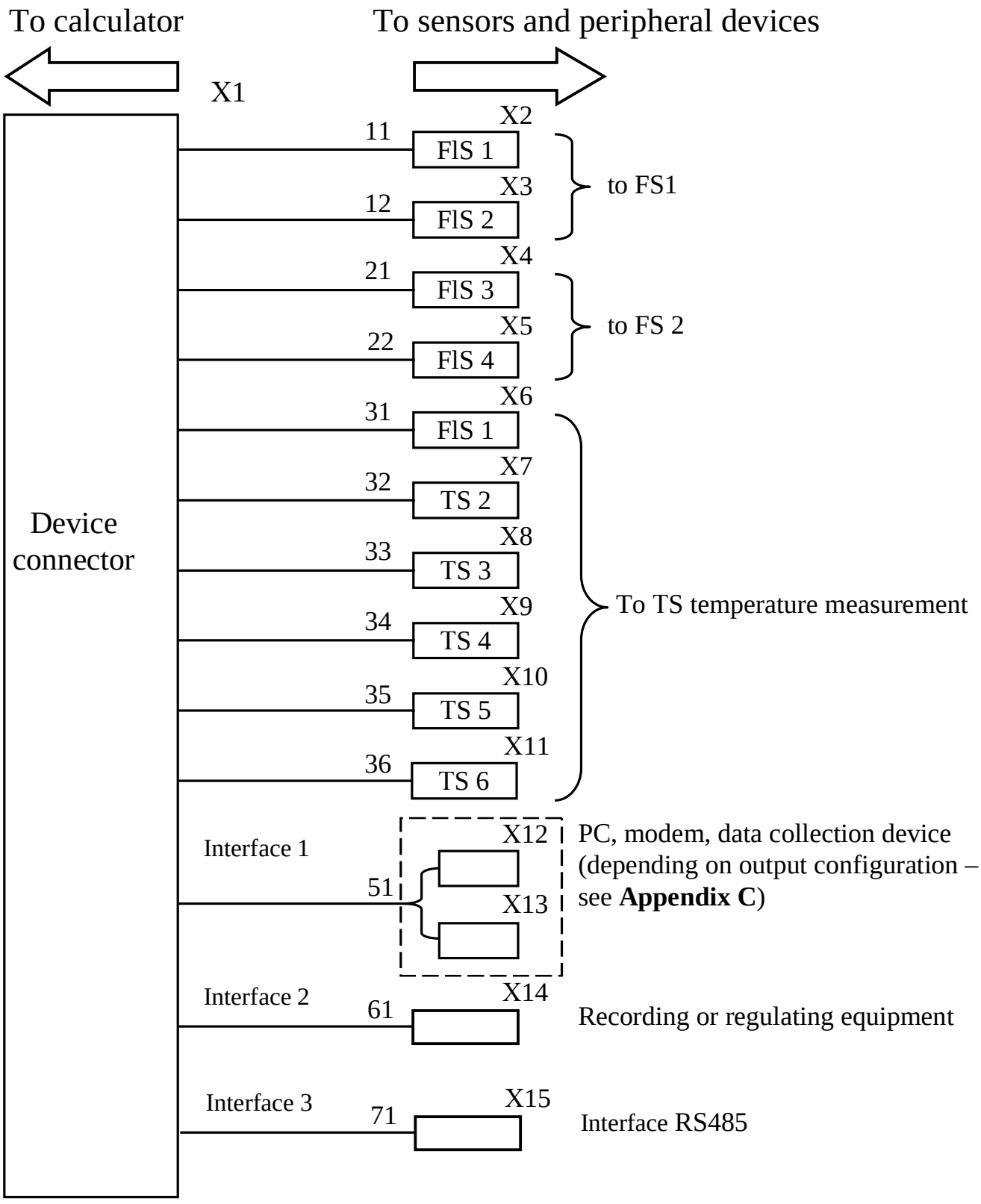


‘Setup/PT parameters’ mode



Structure scheme of device cable.

Complete set: up to 6 TS and no PT **(Cable of configuration "T")**

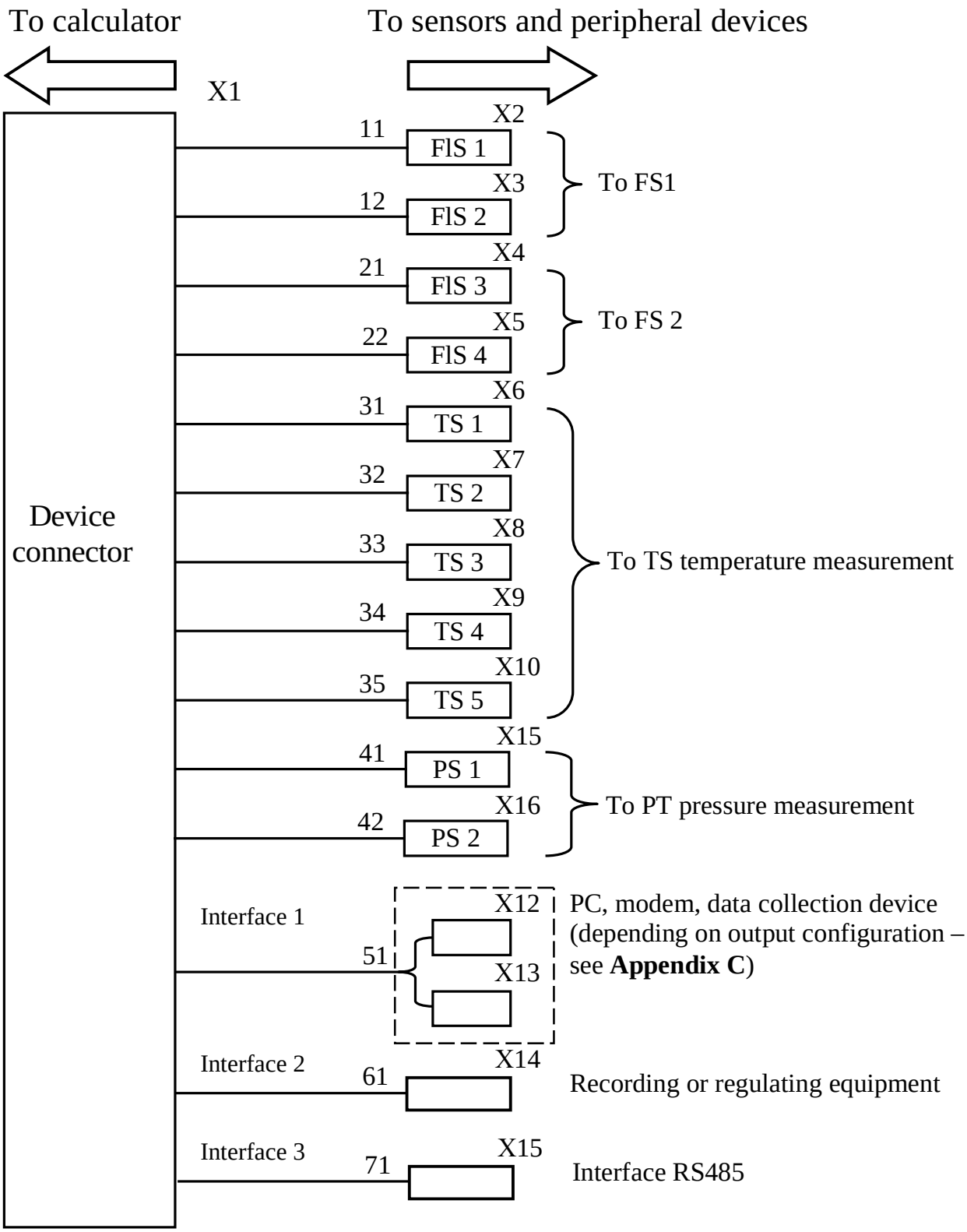


The notice. Numeration of communication lines in figures is indicated according to the table 9.4.

Appendix F

Structure scheme of device cable.

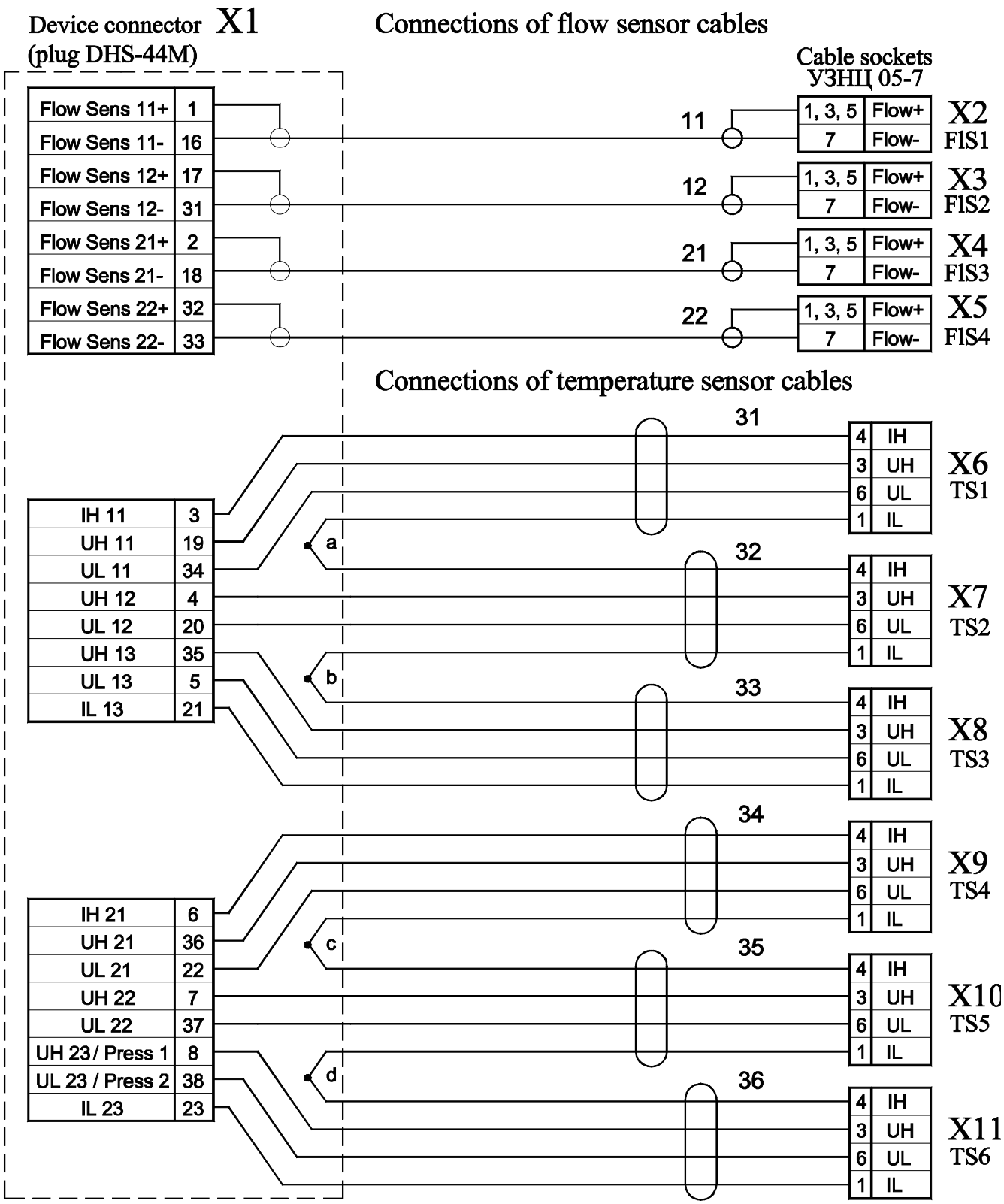
Complete set: up to 5 TS and 2 PT – **(Cable of configuration "P")**



Appendix F

Basic circuit of device cable

Configuration ‘T’. Complete set: 6 temperature sensors, no pressure sensors.



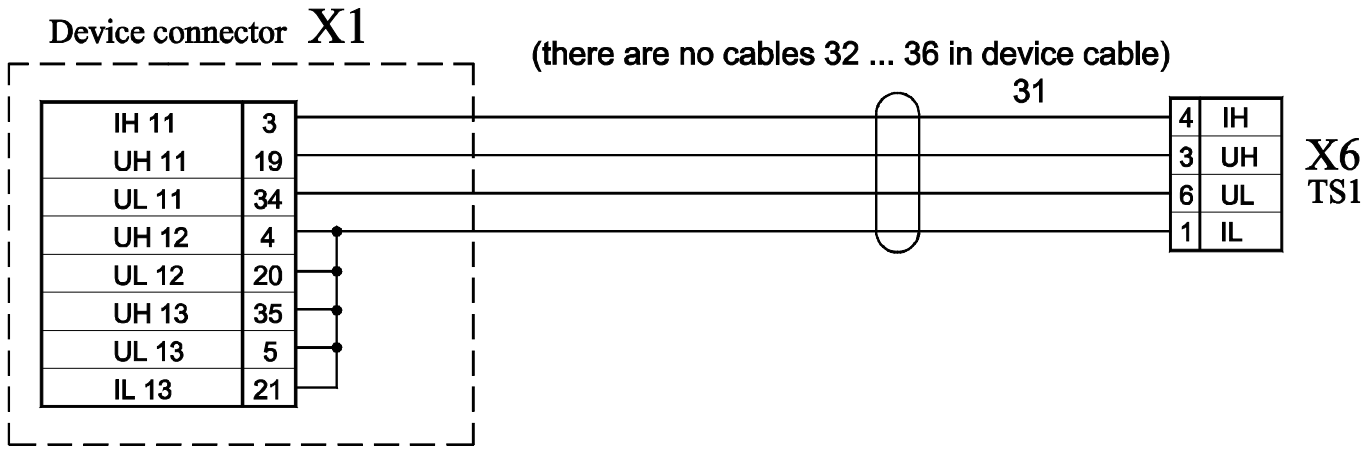
The notice. Interconnection at different number of TS (from 1 up to 5 pieces) in heat meter set are represented in ‘Variants... configuration ‘**T**’ in this Appendix

Appendix F

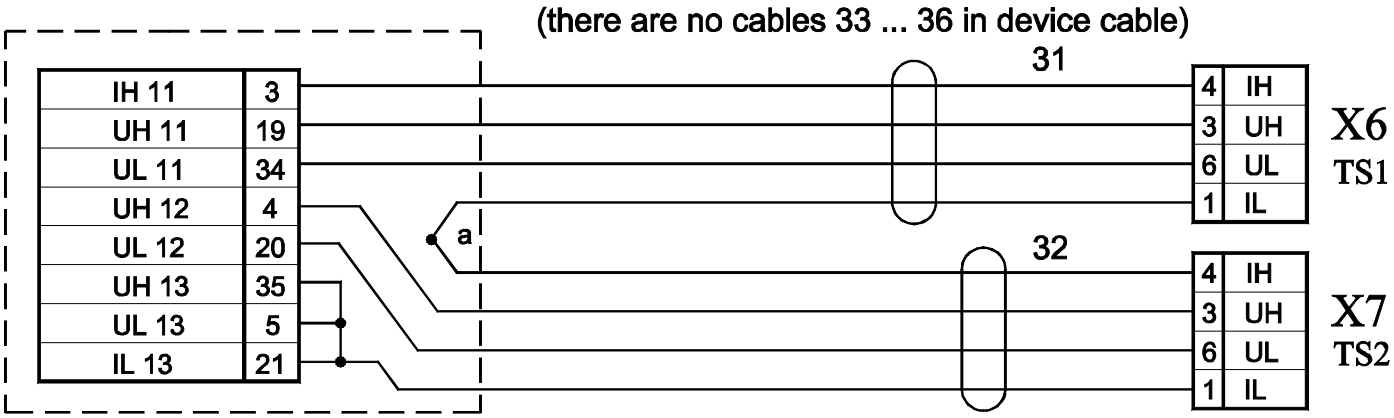
Variants of basic circuit of device cable **configuration 'T'**

(interconnection of communications with TS for different number of TS in meter set)

1. For complete set with **one TS**.



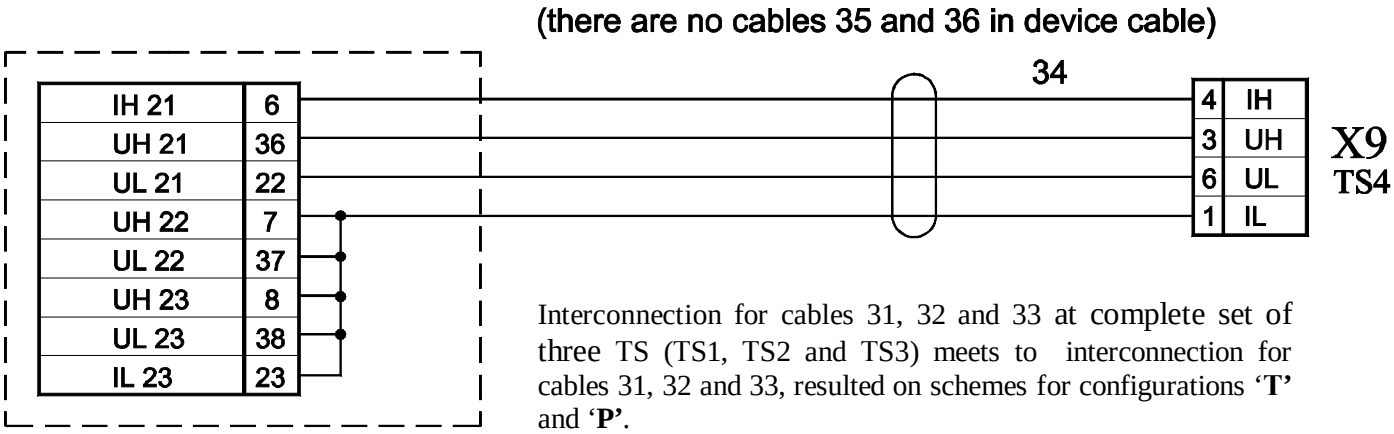
2. For complete set with **two TS**.



3. For complete set with **three TS**.

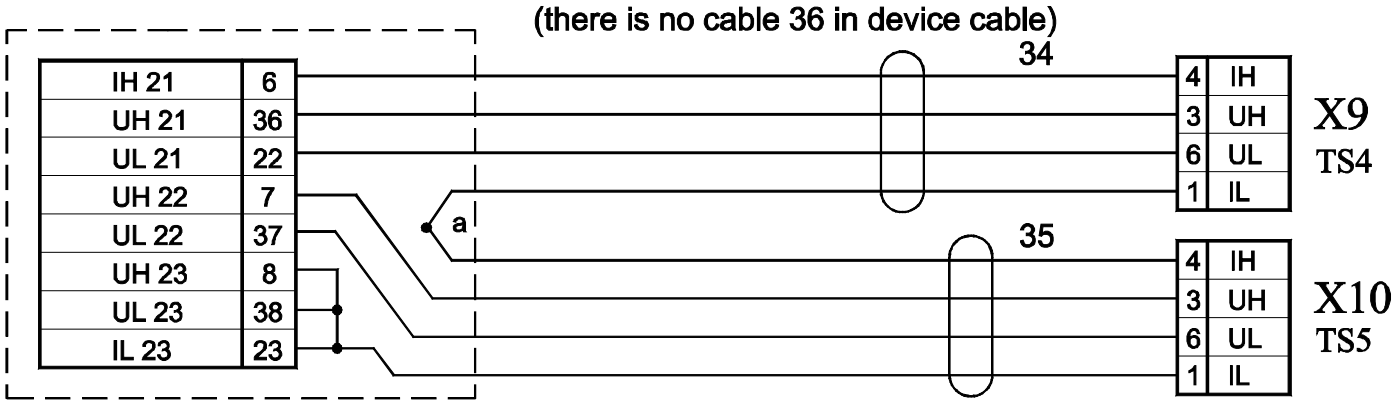
Interconnection for cables 31, 32 and 33 at complete set of three TS (TS1, TS2 and TS3) meets to interconnection for cables 31, 32 and 33, resulted on schemes for configurations '**T'** and '**P'**. There are no cables 34… 36 in device cable.

4. For complete set with **four TS**.



Interconnection for cables 31, 32 and 33 at complete set of three TS (TS1, TS2 and TS3) meets to interconnection for cables 31, 32 and 33, resulted on schemes for configurations '**T'** and '**P'**.

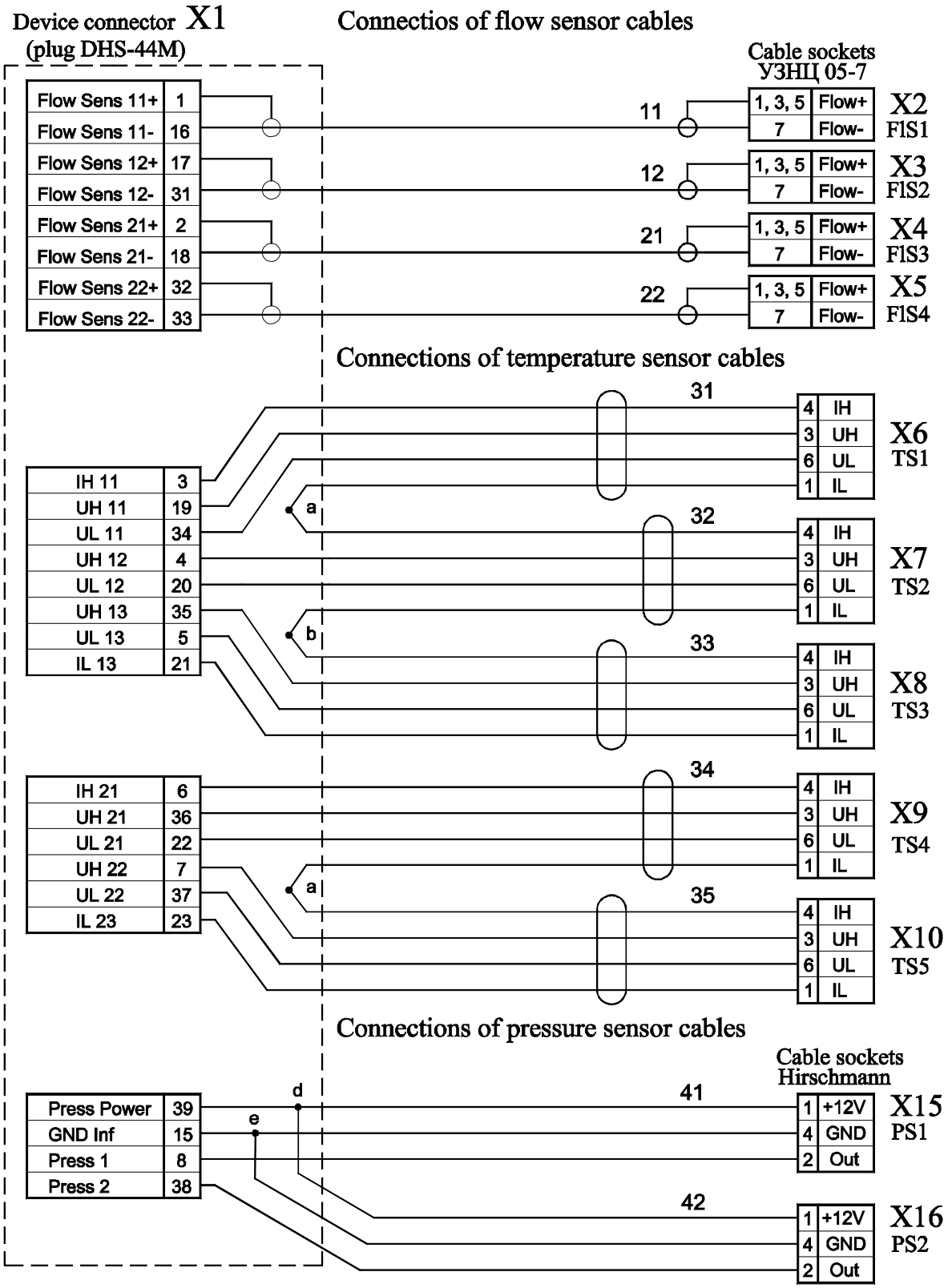
5. For complete set with **five TS**.



Interconnection for cables 31, 32 and 33 at complete set of three TS (TS1, TS2 and TS3) meets to interconnection for cables 31, 32 and 33, resulted on schemes for configurations '**T'** and '**P'**.

Appendix F

Basic circuit of device cable



Configuration ‘P’. Temperature sensors - 5 pieces. Pressure sensors – 2 pieces.

The notice. 1. Interconnections at different number of TS (from 1 up to 4 pieces) in meter complete set are represented in ‘Variants... configuration ‘**P’** in this Appendix

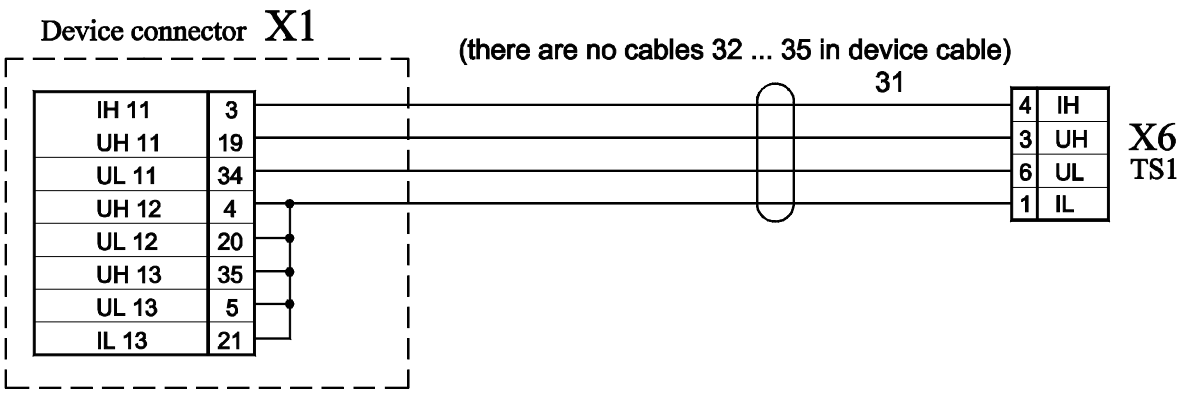
2. Cables to PS have tin-plated pins.

Appendix F

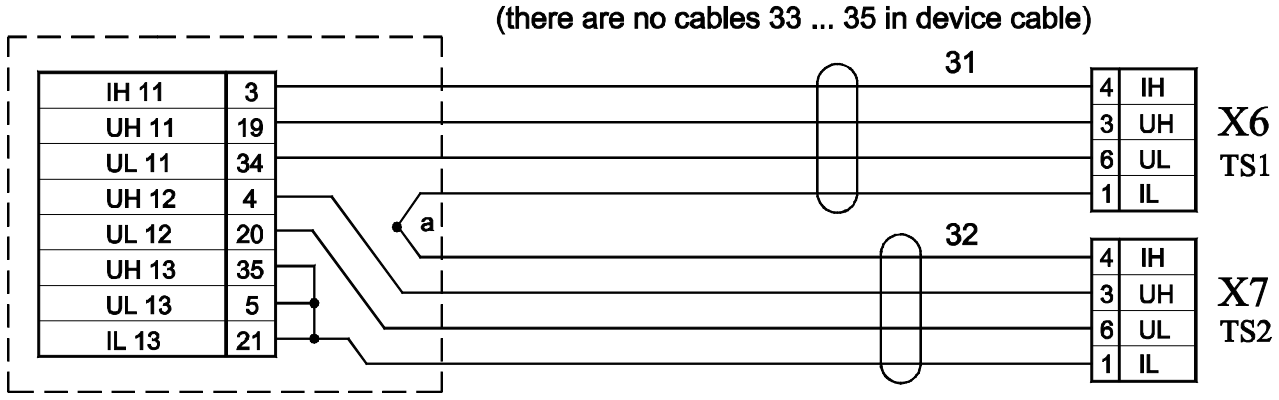
Variants of basic circuit of device cable **configuration 'P'**

(interconnection of communications with TS for different number of TS in meter set)

1. For complete set with **one TS**.



2. For complete set with **two TS**.

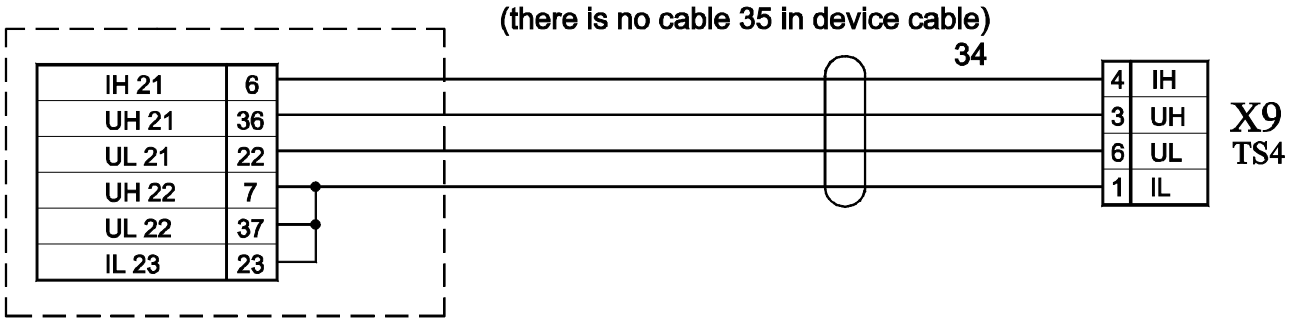


3. For complete set with **three TS**.

Interconnection for cables 31, 32 and 33 at complete set of three TS (TS1, TS2 and TS3) meets to interconnection for cables 31, 32 and 33, resulted on schemes for configurations '**T'** and '**P'**.

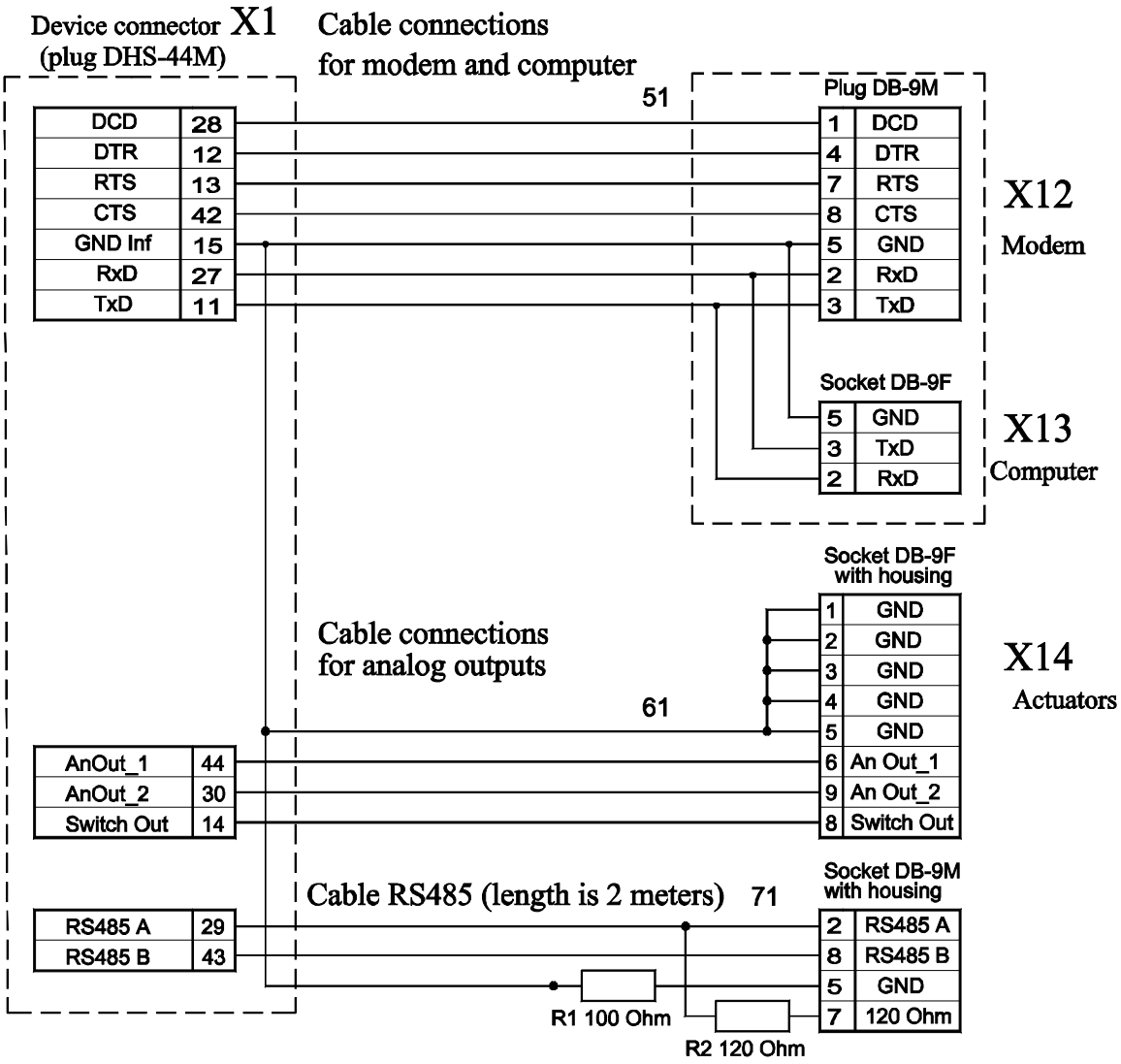
There are no cables 34, 35 in device cable.

4. For complete set with **four TS**.



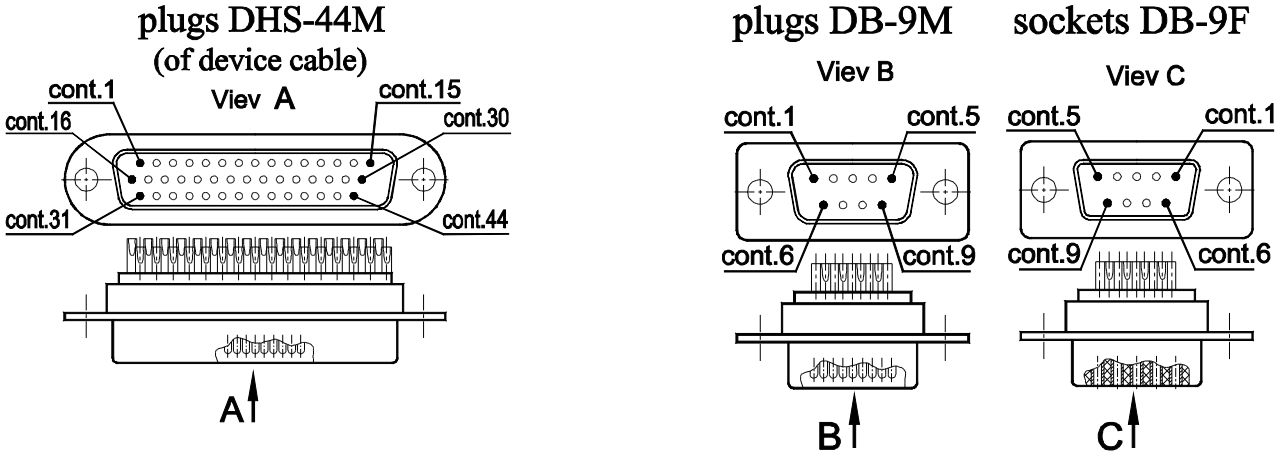
Interconnection for cables 31, 32 and 33 at complete set of three TS (TS1, TS2 and TS3) meets to interconnection for cables 31, 32 and 33, resulted on schemes for configurations '**T'** and '**P'**.

Basic circuit of device cable (interfaces)

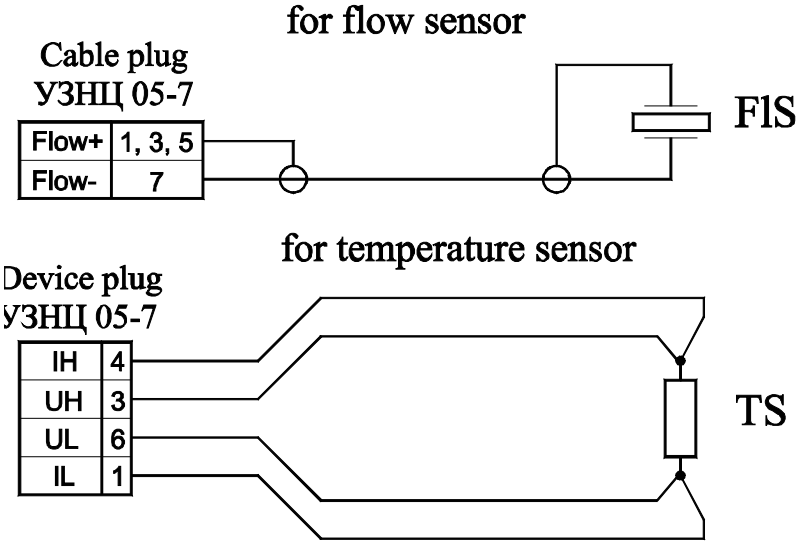


The notice. 1. Connectors X12 and X13 have been mounted in common housing.

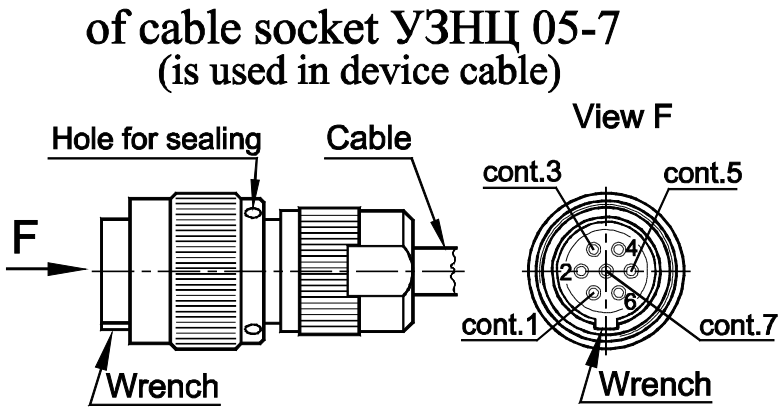
Connector pinout

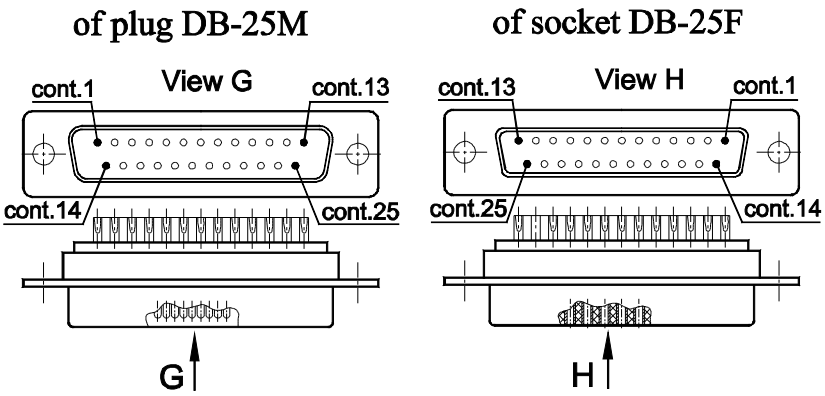


Sensor connection scheme:



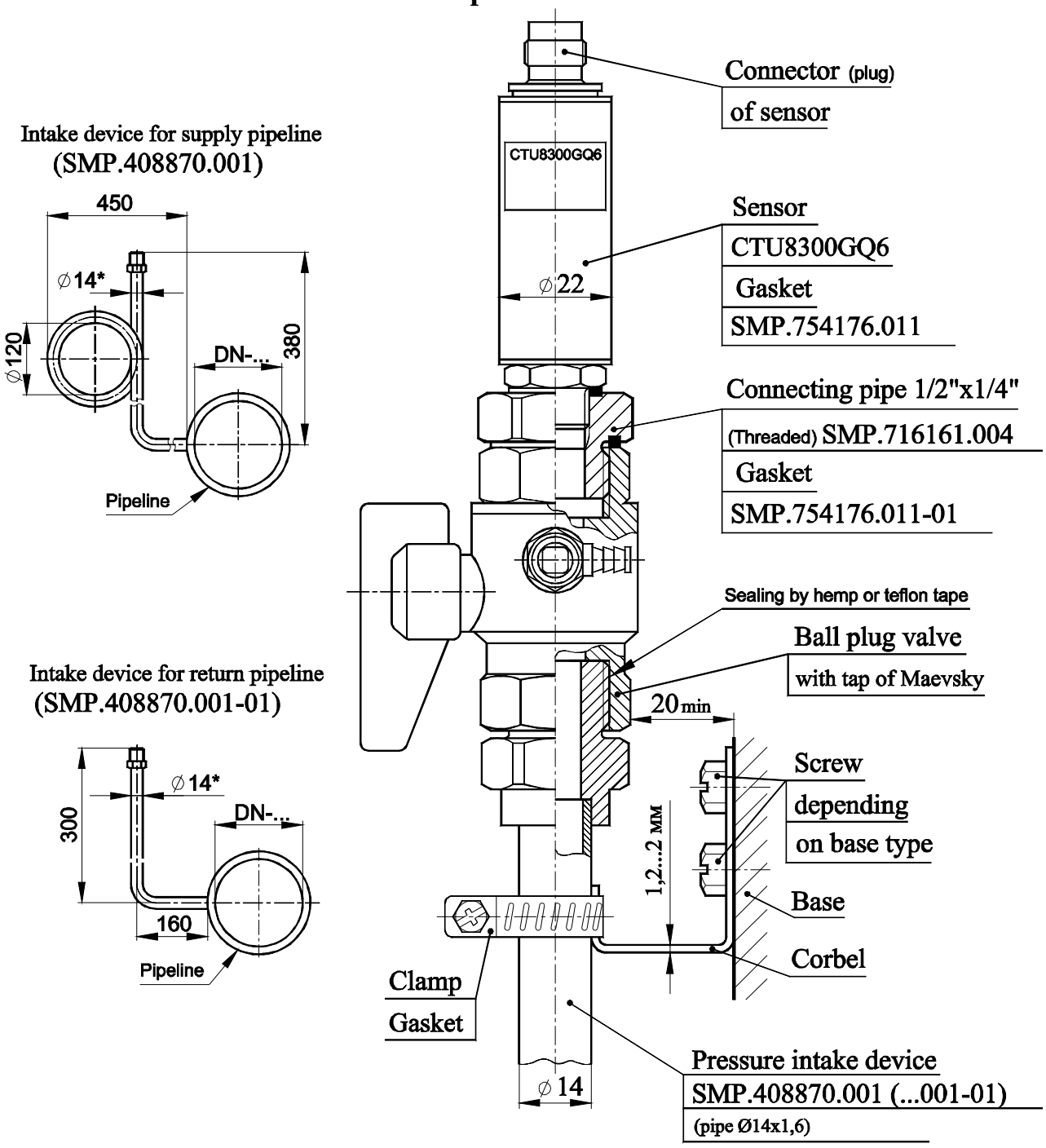
Connectors pinout:





Appendix H
The scheme of pressure sensor mounting

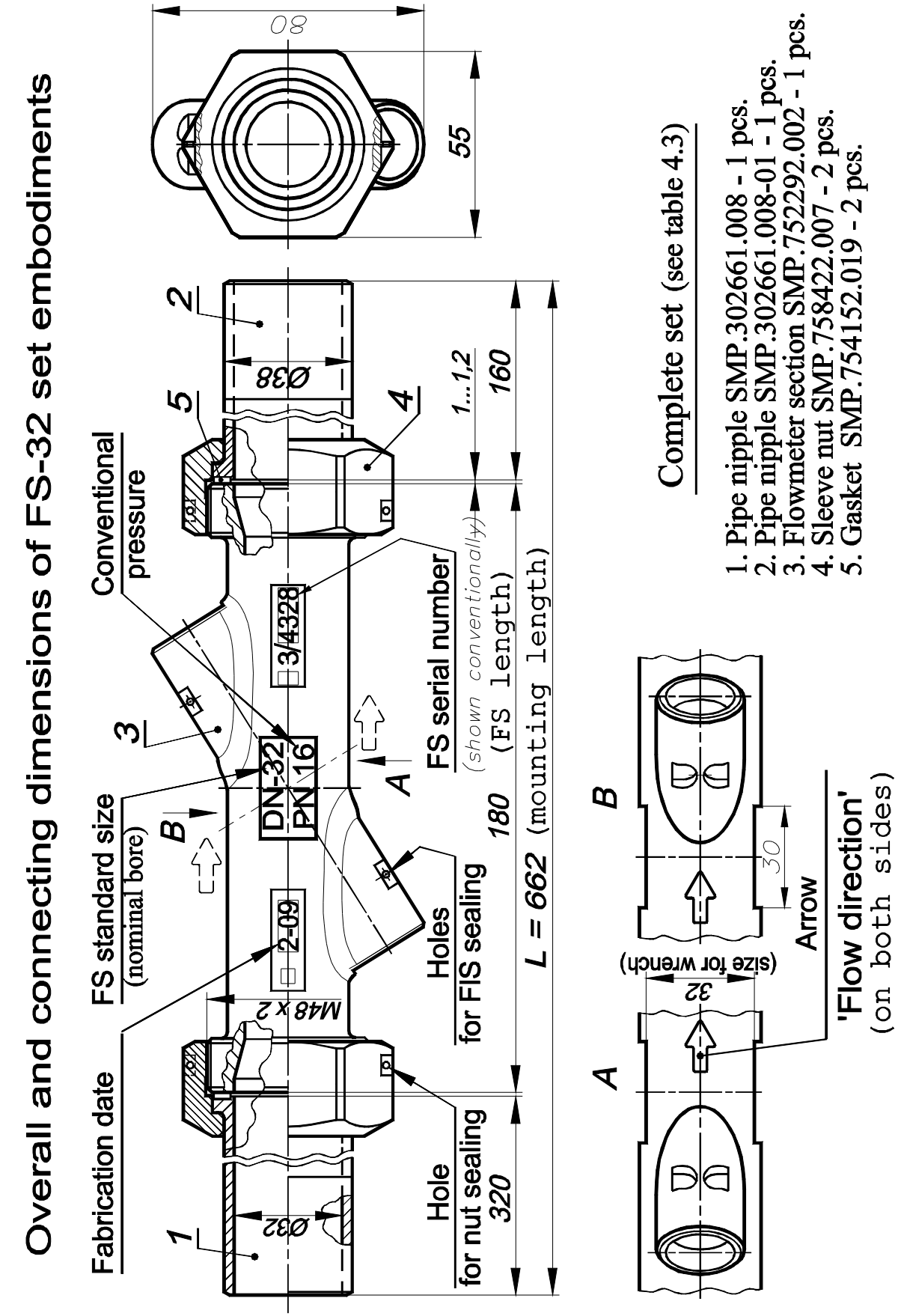
Recommended mounting scheme for pressure sensor CTU8300GQ6 (as example) and dimensions of pressure takeoff devices



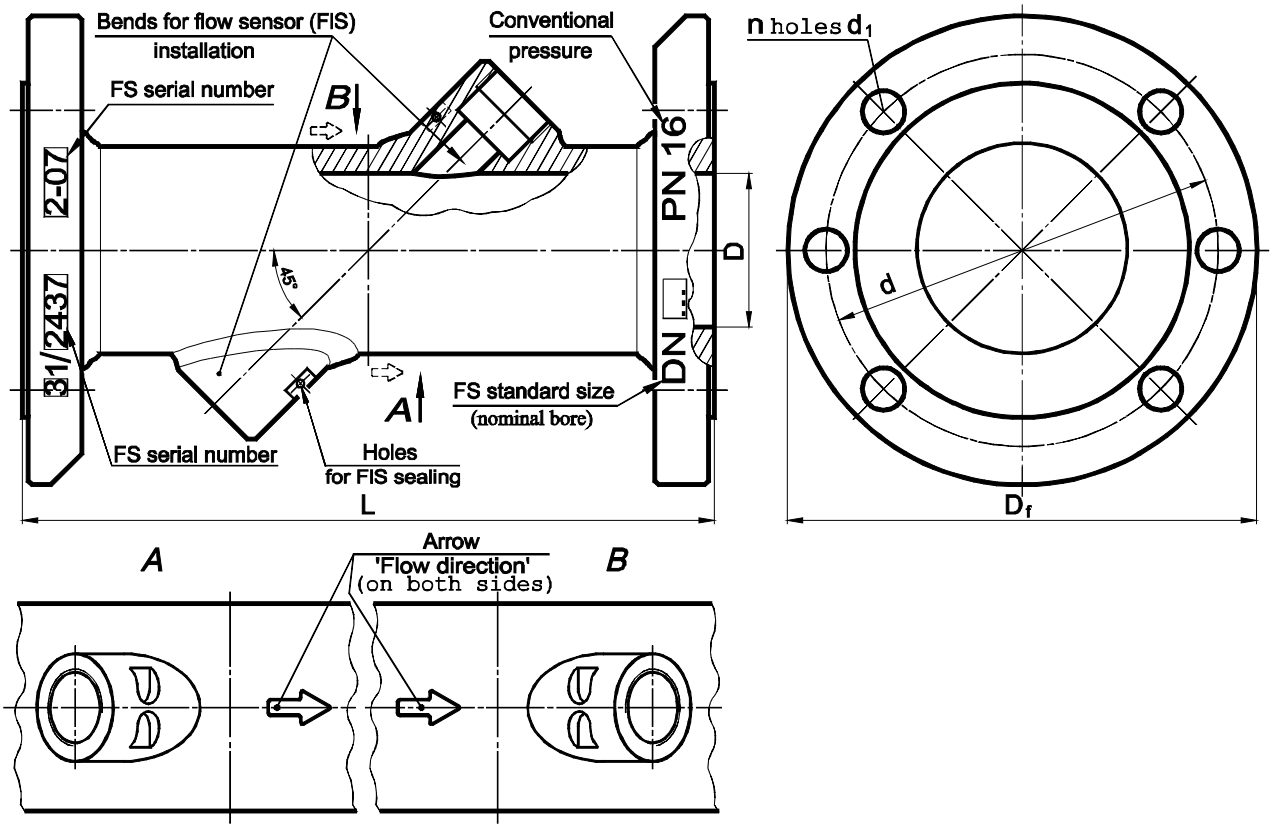
The sensor is mounted in strictly vertical position (see figure).

2. If water characteristics don't meet to technical requirements, then to prevent polymerizing, crystallizing and pollution on a sensor it is necessary to mount a membranous divider with application of dividing organosilicon liquids #2.

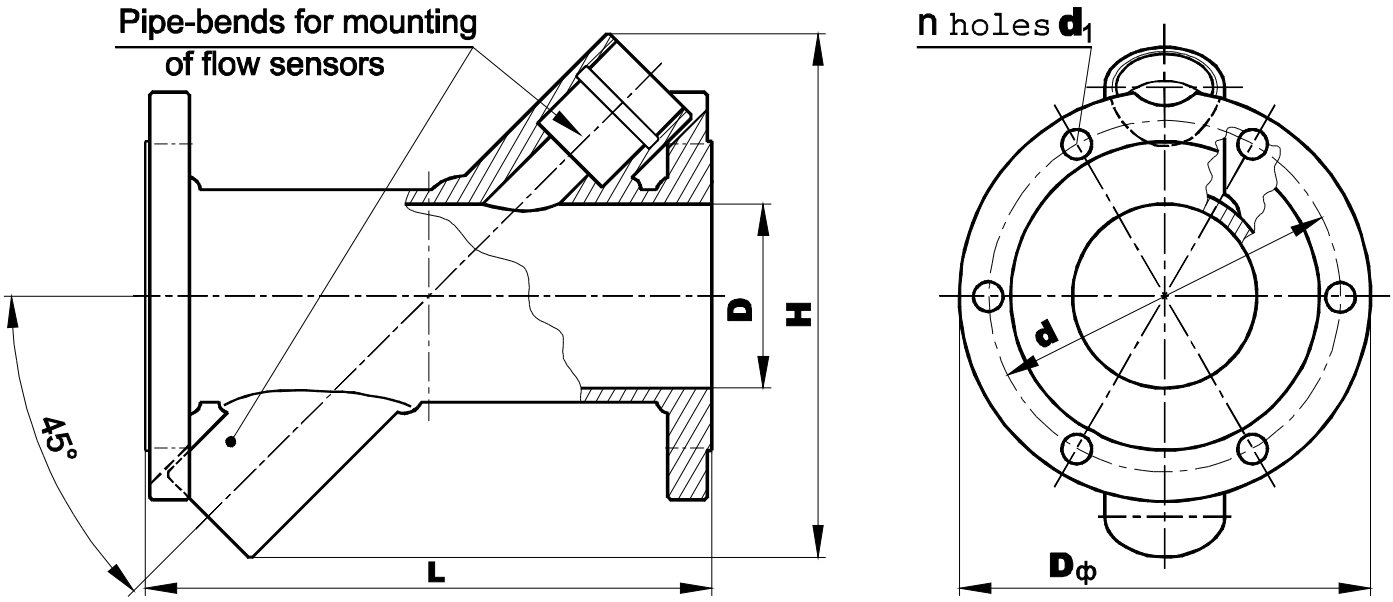
3. The length of remote tubes should provide cooling of water up to temperature not above 70 C.


Overall and connecting dimensions of FS-32 set embodiments
Complete set (see table 4.3)
1. Pipe nipple SMP.302661.008 - 1 pcs.
2. Pipe nipple SMP.302661.008-01 - 1 pcs.
3. Flowmeter section SMP.752292.002 - 1 pcs.
4. Sleeve nut SMP.758422.007 - 2 pcs.
5. Gasket SMP.754152.019 - 2 pcs.
Fabrication date
FS standard size (nominal bore)
Conventional pressure
FS serial number
(shown conventionally)
Holes for FIS sealing
Hole for nut sealing
DN-32
PN 16
3/4328
2-09
M48 x 2
Ø32
Ø38
80
55
1...1,2
160
180
320
L = 662 (mounting length)
(FS length)
(size for wrench)
32
30
Arrow
'Flow direction'
(on both sides)

Overall and connecting dimensions of FS-50...80 set embodiments

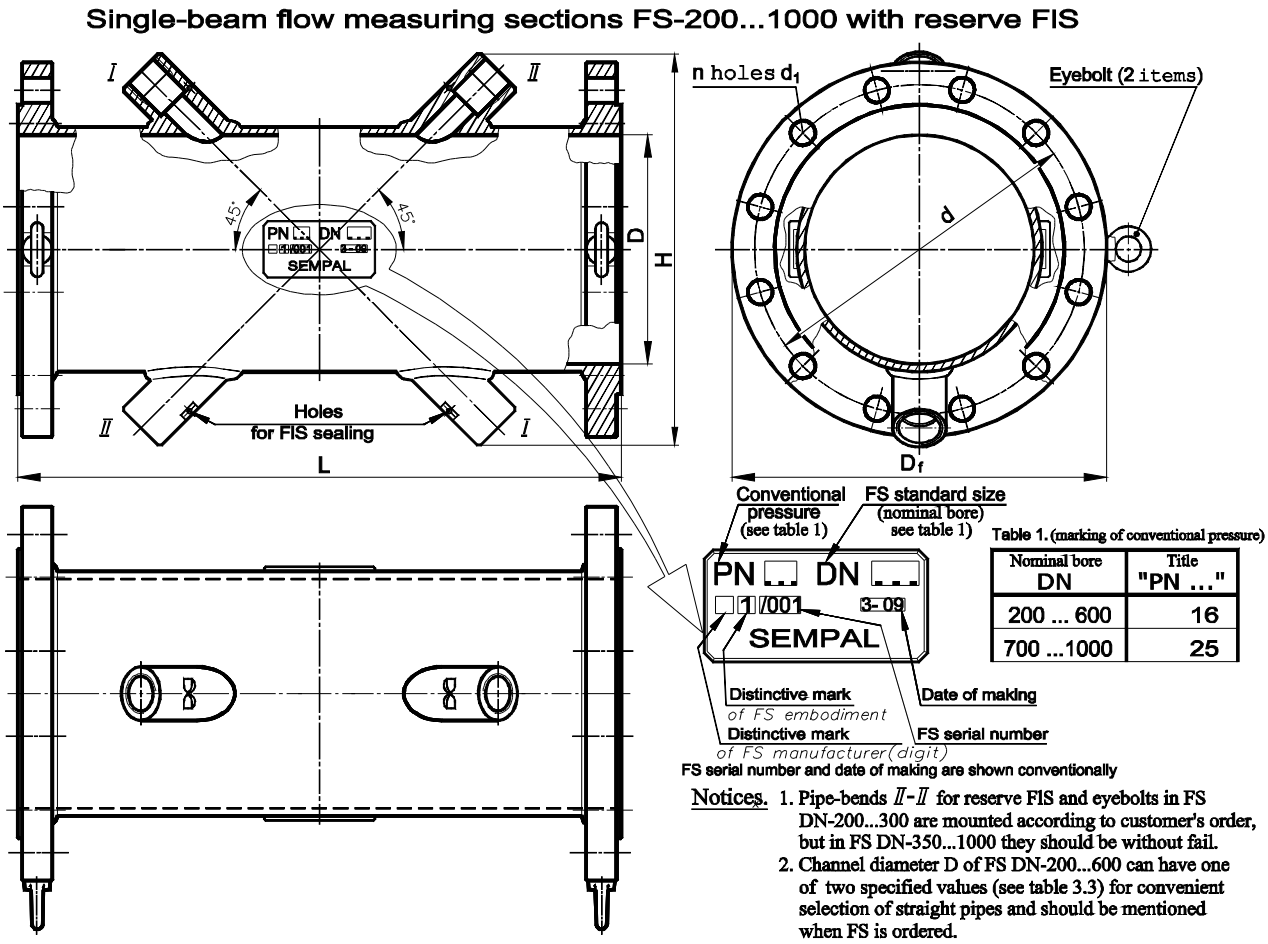


FS DN 50…80

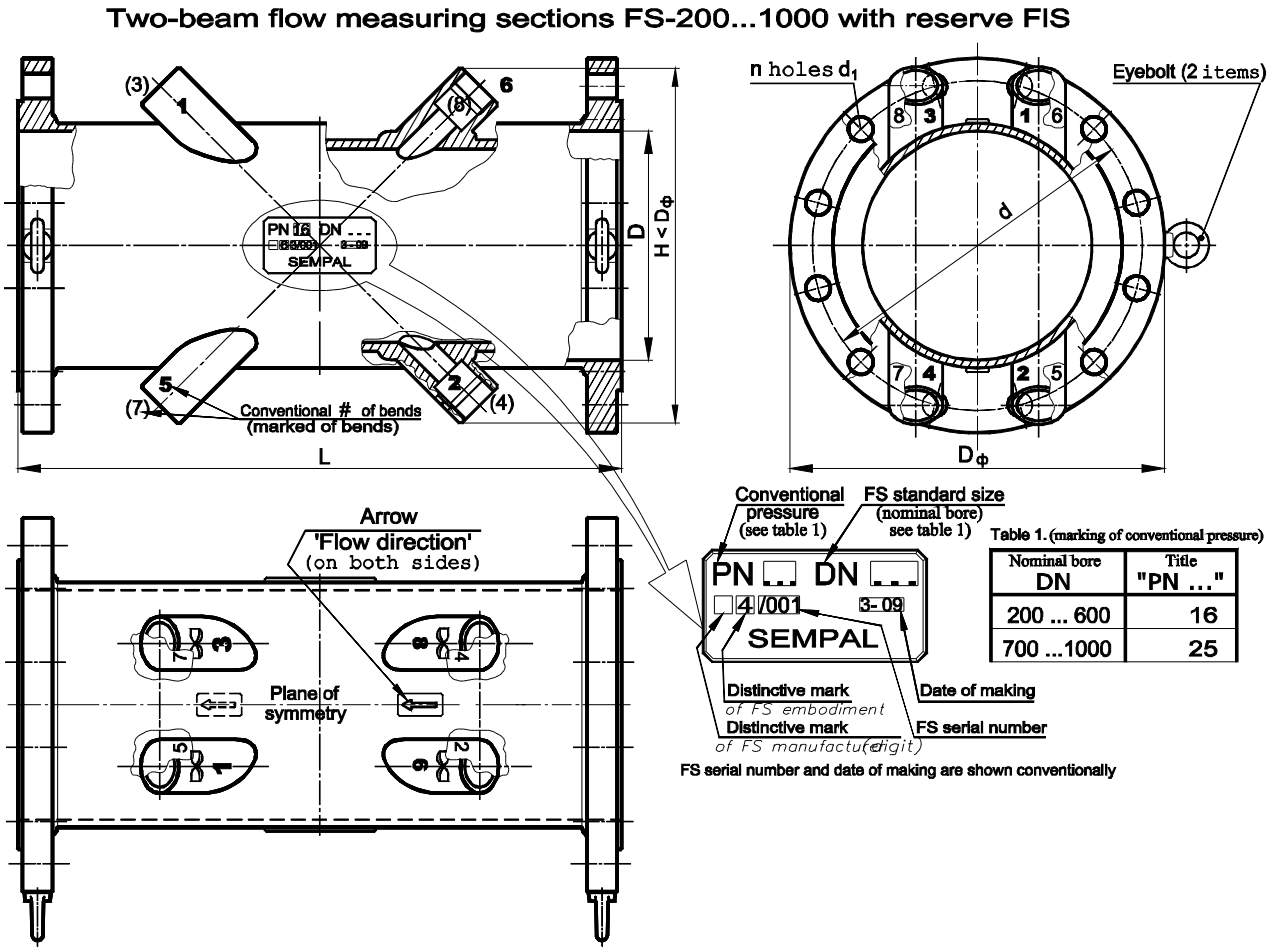


FS DN 100…150

Appendix I


Single-beam flow measuring sections FS-200...1000 with reserve FIS
I
II
45°
45°
PN ... DN ...
SEMPAL
D
H
Holes
for FIS sealing
L
n holes d1
Eyebolt (2 items)
d
Df
Conventional pressure (see table 1)
FS standard size (nominal bore) see table 1)
PN ... DN ...
SEMPAL
Distinctive mark of FS embodiment
Distinctive mark of FS manufacturer(digit)
Date of making
FS serial number
FS serial number and date of making are shown conventionally
Table 1. (marking of conventional pressure)
Nominal bore DN
Title "PN ..."
200 ... 600
16
700 ...1000
25
Notices. 1. Pipe-bends II-II for reserve FIS and eyebolts in FS DN-200...300 are mounted according to customer's order, but in FS DN-350...1000 they should be without fail.
2. Channel diameter D of FS DN-200...600 can have one of two specified values (see table 3.3) for convenient selection of straight pipes and should be mentioned when FS is ordered.

FS DN 200…1000



FS DN 200…1000 Two beam

Appendix J
How to set hydraulic zero

Setting of hydraulic zero is necessary for exception of a systematic measurement error. Its possible occurrence can be caused by difference in manufacturing and real conditions of setting zero.

This phenomenon appears as non-zero meter indications when the real flow velocity is equal to zero.

Device maintenance without zero setting or with incorrect zero setting can lead to significant flow measurement errors, especially in a range of low flow rates.

Zero setting should be carried:

— at device commissioning;

— after mounting (dismantling) of flow sensors (FlS) during routine maintenance;

— after changing of order of cable connections to flow measurement section (FS);

— at inspection of flow measurement channel functionality.

Zero setting in each heat meter channel is desirable to conduct at first out of pipe (on 'tapped' FS) and then (it is obligatory) on the object. If there is no possibility to cut off a heat-carrier, zero setting out of pipe is a unique way for correct device commissioning. Thus it is necessary to provide repeated connection of flow measurement channels cables and FlS, which has been used during zero setting in laboratory conditions. Thus FlS should not be dismantled from 'tapped' FS.

As far as after ending of zero setting, the device saves the certain constant characterizing such connection, so change of the cable connection scheme can lead to flow rate measurement with systematic measurement error.

This negligence in device settings can lead to 'self-running' when at zero heat-carrier velocity the device will display non-zero flow rate.

1 Inspection of correctness for zero setting on 'tapped' FS:

1.1 Assemble a flow measurement section with technological tap at the end face, locate it vertically, fix flow sensors and completely fill FS with preliminary boiled or settled water (to remove air bubbles). Clean end faces of flow sensors from remained air bubbles manually (by a finger or a brush) if they were appeared during filling of FS.

1.2 Connect FlS and resistive temperature detectors (RTD) to corresponding cables.

1.3 Power on the device, thus there should be no error messages concerning flow rate and temperature measurements.

1.4 Enter the mode 'Zero setting' and make setting on both channels simultaneously or separately. While setting, two groups of digits are displayed on the screen. The first one represents the hardware information about zero heat-carrier velocity. This group is stored before following resetting. The second group shows number of zero velocity measurement cycles. For identical FS types these numbers of measurement cycles usually coincide. For different FS types they can be different, within the limits of 30-50 cycles, but do not exceed 63.

1.5 If zero setting has not been completed positively, it is necessary to check up serviceability of cables, quality of connections in sockets and then repeat the previous item.

For successful zero setting on an object it is necessary to provide**:**

— reliable heat-carrier cutting off from both sides of flow measurement section by means of valves;

— qualitative installation and serviceability of flow sensors, temperature sensors and also device entrance cables;
— guaranteed electric contact between grounding contact of the calculator power socket and earthing loop of a premise, in which the meter is installed;
— the level of electromagnetic interference created by surrounding equipment, should not exceed a permissible level for the meter.

Before hydraulic zero setting it is necessary to run the heat meter in heat (water) supply system on the maximal heat-carrier (water) flow rate for half an hour, then to cut off a valve after flow measurement section, to cut off a valve before flow measuring section. Hydraulic zero setting can be conducted in a few minutes after water fluctuations in the tapped section will stop.

If value of the first group of digits, displayed on the meter indicator and registered by the meter as heat-carrier zero velocity noticeably exceeds 500 or number of measurement cycles, then some obstacles are possible on tapped FS:

— air bubbles in FS;
— heat carrier leakage through valves;
— significant level of external electromagnetic noise.

Level of noise can be lowered by having equale potentials between grounding contact of power socket (earthing loop of a premise) and FS. Power backup unit or the external line filter connected to ungrounded socket will not lower a level of noise. Use of the specified devices can give a positive effect only in a complex with a qualitative certified grounding loop.